ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are prepared by use of computer techniques. Each abstract, along with its indexing, is placed on magnetic tape and entered into a permanent data bank. The material prepared each month is published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242.

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ABSTRACTS

00458 **Ackroyd, E. A.; Walton, W. C.; Hills, D. L.** Ground-water contribution to streamflow and its relation to basin characteristics in Minnesota: Minnesota Geol. Survey Rept. Inv. 6, 36 p., illus., tables, 1967.

Streamflow data, used to estimate annual ground-water runoff from 38 drainage basins in Minnesota were analyzed; general conclusions are that ground-water runoff is least from glaciated basins with surficial lake bed sediments or ground moraine underlain by relatively impermeable bedrock, and greatest from glaciated basins with surficial deposits or thick loess underlain by permeable bedrock. Recharge to aquifers is difficult to ascertain; because many aquifers are deeply buried by glacial materials, not all ground water runoff can be diverted into cones of depression, for there is both lateral and vertical movement of water in surficial deposits. Data on runoff can be used to estimate rate of recharge and evaluate potential yields of ground-water reservoirs, but no simple relation exists.—*from* Authors' abstract

Adams, John A. S. *See* Harriss, Robert C. 10374

10462 **Adams, Leason H.; Cohen, Lewis H.** Enthalpy changes as determined from fusion curves in binary systems: Am. Jour. Sci., v. 264, no. 7, p. 543–561, illus., tables, 1966.

The initial slope of a concentration–temperature curve in a binary system without solid solution is dependent on enthalpy of fusion of the concentrated component, and effective molecular weight of the dilute component. If either is known or can be estimated, the other becomes known or can be estimated from concentration–temperature measurements for these binary systems. In the case of binary systems involving solid solution, the two initial slopes can be made to yield useful information on enthalpy of fusion. Assumptions underlying initial-slope calculations in both types of binary systems are specifically enumerated. An exact expression can be derived for ratio of enthalpies of fusion at eutectic of a simple binary system. This ratio depends on heats of mixing of the two components, and the expression yields information on heats of mixing whenever accurate temperature–concentration curves have been obtained.—*from* Authors' abstract

Agogino, George A. *See* Egan, Gail N. 10352

Ahlrichs, James L. *See* Harter, Robert D. 00316

10400 **Ahmad, N.; Jones, Robert L.; Beavers, A. H.** Genesis, mineralogy and related properties of West Indian soils—[Pt.] 1, Bauxitic soils of Jamaica: Soil Sci. Soc. America Proc., v. 30, no. 6, p. 719–722, illus., tables, 1966.

Jamaican bauxite soils of almost pure clay texture which were derived from limestone are compared and characterized. Nitrogen and potassium are very deficient. Phosphorus is present but unavailable in the red bauxite and response to P is low. Much higher P status and availability is found in the brown bauxite. Differences in properties of the two soils are due to internal soil drainage which may be traceable to the permeability of the underlying limestone. Gibbsite, boehmite, and goethite are the principal minerals with chlorite and montmorillonite occurring in trace amounts; montmorillonite occurs only under relatively poorer drained conditions in the brown bauxite soil.—Editor's brief

Akili, Waddah. *See* Andersland, O. B. 00540

10527 **Albritton, Claude C., Jr.** Stratigraphy of the Domebo site, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie-Plains: Mus. Great Plains Contr., no. 1, p. 10–13, illus., 1966.

The headwater gullies of Domebo Branch, Caddo County, Okla., are entrenched in Permian red beds. Downstream from the confluence of the gullies, four benches of Quaternary alluvium, derived chiefly from the Permian Rush Springs sandstone, rise 2, 7, 14, and 40 feet above the stream bed. The alluvium of the highest bench is herein named the Domebo Formation; the type section, divided into lower and upper members, is shown. The upper unit of the lower member, a fossil paludal soil, contains mammoth bones and associated artifacts. About 100 feet downstream, a tree stump rooted in the lower member yielded a radiocarbon date of 11,045±647 B.P., indicating a late Wisconsin age. The three younger alluvial deposits, designated as Q-2, Q-3, and Q-4 in order of decreasing age and level, fill nested channels cut into the Domebo Formation.—V.M.J.

Alder, B. *See* Wasson, John T. 00357

Aldrich, L. T. *See* Hart, Stanley R. 00376

Aldrich, L. T. *See* Hart, S. R. 00614

10546 **Alger, R. P.** Interpretation of electric logs in fresh water wells in unconsolidated formations, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. CC1–CC25, illus., tables, 1966.

The problem in water well log analysis is to determine the quality and quantity of water to be obtained from various strata. In oil fields R_w determination through SP analysis is usually satisfactory; interrelations between concentration, activity, and resistivity are well established because NaCl is the dominant salt in solution. In fresh water other ions become important and the NaCl interrelationship does not apply. The SP is used for determination of fresh water quality, but firm empirical data for locale are required. Resistivity provides the means for determining relative productivities of fresh water sands. Unconsolidated sands generally exhibit uniformly high porosities; however, a surface conductance effect causes the resistivity factor to vary with both R_w and grain size; because permeability is related to grain size, resistivity values indicate relative productivity.—*from* Author's abstract

00549 **Al-Khersan, Hashim F.** Regional factors that control oil and gas accumulation [abs.]: Houston Geol. Soc. Bull., v. 9, no. 5, p. 16, 1967.

Allen, Don. *See* Cheatum, E. P. 10615

Alparone, N. *See* Pirson, S. J. 10564

10340 **Am. Society for Testing and Materials; Walker, Leland J.** (chairman). Vane shear and cone penetration resistance testing of in-situ soils—A symposium presented at the fifth Pacific area national meeting, Seattle, Wash., Nov. 1965: Am. Soc. Testing and Materials Spec. Tech. Pub. 399, 47 p., illus., tables, 1966.

Field testing of *in-situ* soils using vane-shear and cone-penetration methods are being used with increasing frequency and wider acceptance throughout the world. This symposium provides an opportunity for presenting descriptions of these test procedures and state of the art of their techniques and of the evaluation of the test results for engineering usage. Five papers were received for the vane-shear test, of which four were presented; one other paper, "An inspection vane", which was not presented at the symposium is included. Only one paper relating to cone penetration was presented. Five papers are cited separately.—G.D.C.

00540 **Andersland, O. B.; Akili, Waddah.** Stress effect on creep rates of frozen clay soil [with French abs.]: Géotechnique, v. 17, no. 1, p. 27–39, illus., 1967.

Differential creep tests have been carried out on frozen cylindrical clay soil samples to examine the influence of stress on creep rates. Information was also obtained concerning temperature and structure effects on the stress/creep rate relationship. The data and analysis indicate that thermal activation is involved in the creep. An observed constant activation energy supports the idea that one creep mechanism predominates for the stresses and temperatures used. Experimental data indicate a linear relationship between axial stress and reciprocal of temperature for constant creep rates and temperatures lower than -6°C. This provides a means for predicting creep rates at other axial stresses and temperatures based on limited creep data.—G.D.C.

Anderson, Adrian D. *See* Leonhardy, Frank C. 10505

Anderson, Alfred L. *See* Stearns, Harold T. 10600

Anderson, L. A. *See* Keller, G. V. 10393

Anderson, Megan. *See* Stokes, William Lee. 10490

Anderson, Roger Y. *See* Dean, Walter E., Jr. 00541

10411 **Andresen, A.; Sollie, S.** An inspection vane, *in* Vane shear and cone penetration resistance testing of in-situ soils—ASTM Pacific Area Natl. Mtg., 5th, Seattle, Wash., 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 399, p. 3–7, illus., 1966.

The Norwegian Geotechnical Institute has recently developed a light inspection vane borer for field determination of the undrained shear strength in clay. The range of the instrument is from 0 to 2 tons/ft^2 (0 to 20 tons/m^2). It is primarily intended for use in trenches and excavations at a depth not influenced by drying and excavation procedure.—Authors' abstract

Andrews, J. T. *See* Loken, O. H. 10585

Andrews, J. T. *See* Terasmae, J. 10665

00525 **Angino, Ernest E.** Distribution of iron in Recent carbonate sediments, *in* Short papers on research in 1966: Kansas Geol. Survey Bull. 187, pt. 1, p. 3–5, illus., table, 1967.

Iron showed a strong covariance with insoluble (in H_2O_2, $HC_2H_3O_2$ and H_2O) material present in Recent carbonate sediments from Vieques Passage, Puerto Rico. The insoluble fraction, making up about 11 percent (range 8–17) of the sediment, carries approximately 83 percent (range 70–98) of the total iron present in the sediment. The mean Fe concentration of the samples was 0.48 percent with a range of 0.08 to 1.0 percent and a δ of 0.16.—Author's abstract

Angino, Ernest E. *See* Galle, O. Karmie. 00526

00361 **Antoine, John; Bryant, William; Jones, Bill.** Structural features of continental shelf, slope, and scarp, northeastern Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 2, p. 257–262, illus., 1967.

Seismic reflection, magnetic, and piston-coring data acquired on cruises of the R. V. Alaminos, Texas A and M University, have revealed the following features in the area of the continental shelf, slope, and scarp south of the Florida Panhandle: (1) a probable salt dome approximately 75 miles south-southeast of Pensacola, Fla.; (2) a large dome-like feature of possible igneous origin 50 miles south of Valparaiso, Fla.; (3) the possible existence of buried reefs bordering the Florida scarp; and (4) Cretaceous outcrops on the Florida scarp.—Authors' summary

10639 **Ardmore Geological Society.** Pennsylvanian of the Ardmore Basin, southern Oklahoma—Field Conf. 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., 50 p., illus., tables, 1966.

The guidebook includes, besides two road logs, six papers which are cited individually, and an outcrop map.—E.S.L.

10640 **Ardmore Geological Society.** (Field Trip Committee). Memorial to Harold T. Weichbrodt (1921–1966), *in* Pennsylvanian of the Ardmore Basin, southern Oklahoma—Ardmore Geol. Soc., Field Conf. 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., p. 5, portrait, 1966.

10344 **Arigos, Luis Eduardo.** Conceptos para la definición del agua en relación al Sistema Suelo–Agua: Ingeniería Civil, v. 17, no. 4, p. 281–285, 1966.

Four concepts used to define water in the system soil–water are the hydrogeologic, edaphologic, geotectonic, and geochemical.—E.S.L.

00370 **Armstrong, Augustus K.; Holcomb, Lee D.** Interim report on Mississippian Arroyo Peñasco Formation of north–central New Mexico: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 417–424, illus., 1967.

The Arroyo Peñasco Formation is a persistent sequence of alternating carbonate rock types in the mountain ranges of north–central New Mexico. These rocks are of late Osage to middle Meramec age, as determined by field, micropaleontologic, and carbonate petrographic studies. This conclusion is in sharp conflict with recently published concepts of the age and geologic history of the pre–Pennsylvanian Paleozoic rocks of north–central New Mexico.—W.L.A.

10369 **Armstrong, Richard Lee; Hansen, Edward.** Cordilleran infrastructure in the eastern Great Basin: Am. Jour. Sci., v. 264, no. 2, p. 112–127, illus., tables, 1966.

Reconnaissance of the almandine–amphibolite facies rocks of the Raft River, Grouse Creek, and Ruby Ranges in the eastern Great Basin indicates the presence of recumbent folds with axial–surface schistosity displayed on scales up to thousands of feet. The regional structural grain parallels major trends of the Cordilleran geosyncline. The metamorphic facies and fabric of all metamorphic rocks in these areas are due to post–Triassic, pre–Lower Cretaceous metamorphism. Structural analogies with other mountain chains suggest that the medium– and high–grade metamorphic rocks in the eastern Great Basin are part of a Cordilleran infrastructure and that they may be separated from low–grade and nonmetamorphic rocks by a zone of steep metamorphic gradients and complex shearing caused by differential movement of warm fluid rocks flowing beneath a cool competent cover, the suprastructure.—*from* Authors' abstract

00413 **Aron, Gert.** Analysis of parameters of an unconfined aquifer—Discussion [of paper 4901, by G. J. Kriz, 1966]: Am. Soc. Civil Engineers Proc., v. 93, Jour. Hydraulics Div., no. HY 2, p. 109, 1967.

The graphical method to determine aquifer characteristics in an unconfined aquifer is considered admirably simple. A closer definition of the hydraulic head dimension might be "h_r = original saturated thickness of the aquifer". The authors' definition (ibid., v. 92, no. HY 5, p. 49–56, 1966) could cause confusion if read in connection with another of their papers.—G.D.C.

Avadisian, A. *See* Pirson, S. J. 10564

10456 **Axelrod, Daniel I.** A method for determining the altitudes of Tertiary floras: Palaeobotanist, v. 14, nos. 1–3, p. 144–171, illus., tables, 1966.

A method for determining altitudes of ET (effective temperature) at modern upland forest stations from ET at lowland stations with relation to temperateness and annual range of temperature, using nomograms and graphic scales, is applied to Tertiary floras, drawing inferences from modern forests in regions of high temperateness. Altitudes are determined for: late Eocene subalpine forest in northeastern Nevada, Eocene mixed deciduous hardwood forest in ancestral Great Smoky Mountains, middle Miocene floras of Columbia Plateau, Eocene to Oligocene floras of Pacific coast. Altitudinal zonation of Tertiary climate exerted control on distribution and composition of forests much as today; a rise in altitude during Tertiary corresponds

to time transgression. Analysis of secular trend of Tertiary climate should be based on sequences of floras in local areas at or near sea level.—V.M.J.

10459 **Axelrod, Daniel I.** Potassium-argon ages of some western Tertiary floras: Am. Jour. Sci., v. 264, no. 7, p. 497–506, table, 1966.

Potassium-argon dates indicate an Eocene age for six Tertiary floras that represent vegetation zones as diverse as mixed deciduous hardwood forest, conifer-hardwood forest, and subalpine forest. Paleobotanical age criteria suggest these upland floras are much younger, confirming evidence that indicates Eocene forests that lived in regions of temperate climate had the aspect of Neogene floras. Certain potassium-argon dates previously assigned to Tertiary floras disagree with paleobotanical evidence for their age. Some of the discrepancies reflect the problem of altitude and the floras of younger aspect that lived there, but others appear to be due to dating rocks not associated with the floras, to contaminated samples, and to other reasons.—Author's abstract

00369 **Baars, D. L.; Parker, J. William; Chronic, John.** Revised stratigraphic nomenclature of Pennsylvanian System, Paradox Basin: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 393–403, illus., table, 1967.

A system of simple formal rock-stratigraphic and time-stratigraphic units is proposed for the Pennsylvanian rocks of the Paradox basin that is usable even in difficult transition areas where evaporite facies grade into shelf carbonate and terrigenous clastic rocks. The time-stratigraphic system uses "pay zones" of petroleum geologists. These units are bounded by dark-colored shales which are approximate time-marker beds by fusulinid determinations. Alternate type sections are proposed for some formations.—W.C.C.

10496 **Baird, David M.** Rocks and scenery of Terra Nova National Park: Canada Geol. Survey Misc. Rept. 12, 52 p., illus., 1966.

The park, about 150 sq mi in the northeastern corner of Newfoundland, is underlain by Precambrian rocks intruded by mid-Paleozoic granite masses, and younger dikes. The Connecting Point, Love Cove, and Musgravetown Groups form northeast-southwest trending belts. The lowest of three preglacial erosion surfaces is observed over most of the park; glaciers rounded the hills and scoured the valleys. Deposits left by the glaciers dammed streams to form lakes and bogs and scattered granite boulders everywhere. Evidence of sea-level changes is described. A roadlog accompanies the report.—E.S.L.

00314 **Baird, Donald; Carroll, Robert L.** *Captorhinus vs. Hypopnous* (Reptilia, Captorhinomorpha): Jour. Paleontology, v. 41, no. 1, p. 264–265, 1967.

Captorhinus Cope 1896 is conserved as a senior synonym of *Hypopnous* Cope 1896. *Hypopnous squalidens* is synonymized with *Captorhinus aguti*.—F.C.W.

10388 **Baker, Don.** The National Bureau of Standards and its contributions to geophysics: Am. Geophys. Union Trans., v. 47, no. 4, p. 563–568, illus., 1966.

National Bureau of Standards contributions to geophysics fall into two categories: development of instruments, data, techniques, and theories useful in geophysics; and provision of the necessary measurement competence. Contributions to gravity measurements, the IGY and IQSY, seismology, and atmospheric and ionospheric research are discussed.—D.B.V.

Baker, J. A. *See* Sammel, E. Z. 10545

10426 **Baker, W. E.** An *x*-ray diffraction study of synthetic members of the pyromorphite series: Am. Mineralogist, v. 51, nos. 11–12, p. 1712–1721, illus., tables, 1966.

Twenty-five compounds within the composition field covered by the pyromorphite series were prepared by simple hydrous synthesis at 60–80°C. X-ray powder diffraction examination was used to record compositional differences and to examine

the solid solution characteristics of the series. Contrary to the views expressed in modern texts, complete solid solution between the end members was found to exist. [Cell dimensions are included].—*from* Author's abstract

10548 **Baldwin, W. F.; Caldwell, R. L.; Glenn, E. E.; Hickman, J. B.; Norton, L. J.** Slim hole logging in Colorado oil shale, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. C1–C17, illus., tables, 1966.

Experimental logs were run in slim holes in the Colorado oil shale to determine potential oil yield. Small diameter (1 3/4″ O.D.) acoustic and gamma-gamma density tools were run in nominal 3″ diameter holes. The logs were calibrated using density and acoustic log results reported in the literature and borehole models of known density. Reasonable values of oil yield were obtained. Later the log results were compared with assay analysis of cores taken from the holes logged and good agreement was found.—Authors' abstract

00402 **Barnard, Walther M.** Synthesis of pyrite from chloride-bearing solutions: Econ. Geology, v. 62, no. 1, p. 138–141, table, 1967.

Pyrite was dissolved at one end and precipitated at the other end of a temperature-gradient reaction vessel containing chloride solutions at temperatures of 400°C and 500°C.—W.S.W.

00450 **Barnes, Farrell F.** Coal resources of Alaska: U.S. Geol. Survey Bull. 1242-B, p. B1–B36, illus., tables, 1967.

The original coal resources of Alaska are estimated at 130 billion tons, including about 19 billion bituminous coal and 111 billion subbituminous coal and lignite. The principal coal-bearing areas are northern Alaska, the Nenana, Jarvis Creek, and Broad Pass coal fields on the flanks of the Alaska Range, and the Matanuska, Susitna, and Kenai fields in the Cook Inlet basin. Most of these areas contain only subbituminous coal and lignite. The exceptions are northern Alaska, where both bituminous and subbituminous coal are present, and the Matanuska field, which contains bituminous coal. Alaska coal production increased rapidly during and after World War II mostly from the Nenana (subbituminous) and Matanuska (bituminous) coal fields.—F.F.B.

10604 **Barnes, Robert H.; Lounsbury, Richard E.; Moore, Gerald K.** Geologic map of the Graves Spring quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 41-SW, scale 1:24,000, separate text, 1966.

The accompanying text, "Mineral resources summary of the Graves Spring quadrangle, Tennessee," by L. T. Larson, 1966, is cited separately.—M.C.M.

10605 **Barnes, Robert H.; Marcher, Melvin V.** Geologic map of the Bonnertown quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 52-SE, scale 1:24,000, separate text, 1966.

The text accompanying this map, "Mineral resources summary of the Bonnertown quadrangle, Tennessee," by R. A. Miller, 1966, is cited separately.—M.C.M.

10588 **Barnett, D. M.** Preliminary field investigations of movement on certain Arctic slope forms: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 8, no. 4, p. 377–382, illus., 1966.

Three sites at the head of Inugsuin Fiord, east Baffin Island, Northwest Territories, are being studied. Site 1 is an embayment with interrelated slopes, on which no movement was observed from 1964–66. Site 2 is on solifluction lobes along the river bank. Movement occurred between successive measurements; appeared to be radial, nonuniform, and principally between September and June; and totalled 4.5 to 5.2 cm for the two years. Site 3 observations were made on a scree cone, 650 feet high. Active development occurs during the warmest months.—E.S.L.

Barraclough, Jack T. *See* Musgrove, Rufus H. 10553

10435 **Barrows, H. L.; Simpson, E. C.; Tu, H. Y.** Formation of surface coatings on limestone particles in soils: Soil Sci. Soc. America Proc., v. 30, no. 3, p. 317–320, illus., tables, 1966.

High purity 12- to 14-mesh calcite limestone was mixed into acid soils containing relatively large amounts of either P, Al or Mn. These mixtures were equilibrated for 12 months, undergoing wetting and partial drying cycles; samples of each were withdrawn periodically and limestone particles were recovered and examined. The surface of particles equilibrated in the high-P soil developed a porous, white granular coating, which, after 7 months, varied from about 0.03 to 0.1 mm in thickness. It was concluded that the coating formed through the combined processes of weathering, recrystallization of calcite, and adsorption and/or precipitation of PO_4 from the soil.—*from* Authors' abstract

10584 **Barry, R. G.** Meteorological aspects of the glacial history of Labrador–Ungava with special reference to atmospheric vapour transport [with French abs.]: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 8, no. 4, p. 319–340, illus., tables, 1966.

The Labrador–Ungava Peninsula, Labrador–Quebec, is a key region in North American glacial history. Various circulation models proposed to account for the glaciation are examined in the light of patterns of vapor transport and flux convergence over northeastern North America during two winter seasons. No unique circulation type appears responsible for large flux convergence over the region, although it seems possible that incursions of cyclonic easterly flow with low index circulations are important for the development of an ice sheet. The contribution of different airflow patterns to the seasonal snowfall is examined for stations in the area, and the significance of the amounts discussed. Statistical probabilities of low summer temperatures are also considered. In conclusion are given some rough estimates of the time required for ice-sheet growth.—E.S.L.

00320 **Bassett, J. R.; McDaniel, A. R.** Trafficability of four loess soils: Soil Sci. Soc. America Proc., v. 31, no. 1, p. 115–117, illus., tables, 1967.

Soil trafficability can be determined from the grain-size distribution, plasticity, organic matter content, and moisture content of a 15 cm-thick zone called the critical layer. Samples of the Loring, Grenada, Calloway, and Henry silt loams from 65 sites located on the loess band that stretches from northeast Louisiana to northeast Arkansas were used to determine the moisture-strength relations and the feasibility of grouping them for trafficability. Evidence presented suggests that, at the same moisture content, the four soils are similar in strength. However, strength varied so much within individual series that little accuracy would be lost by grouping them without regard to their drainage characteristics. The group equation relating strength to moisture content accounted for 66 percent of the strength variation.—B.S.H.

00524 **Batten, Roger L.** Thoughts on the genus *Ptychomphalina* Fischer, 1887 and the family Eotomariidae Wenz, 1938: Jour. Paleontology, v. 41, no. 1, p. 261–264, 1967.

Ptychomphalina is probably an unnecessary term, and species currently placed in this genus could comfortably be assigned to such genera as *Platyteichum, Mourlonia, or Peruvispira*. The concept of the family Eotomariidae for some Paleozoic pleurotomariaceans is upheld, and the author argues against the return to a single family designation for Paleozoic pleurotomariaceans.—J.P.

10554 **Baxter, Robert W.** The growth habit of *Lepidodendron serratum* Felix: Palaeobotanist, v. 14, nos. 1–3, p. 1–4, illus., 1966.

The question of whether all species of the Paleozoic pteridophyte *Lepidodendron* were arborescent with secondary growth, or whether some may have been of vine or semiherbaceous habit with only primary tissues, was investigated by observation of over 200 specimens of *L. serratum* in sectioned coal balls from the Middle

Pennsylvanian Fleming coal of southeastern Kansas. None of the stem fragments, many of which reached an apparent maximum diameter of 10 cm, showed any form of secondary growth, vascular or periderm. The transverse section of one stem was distinctively asymmetrical, with the stele in a marginal position and all the leaf traces leading to leaf bases on the side of the stem opposite the stele—a type of anatomy found in many living lianas. An emended diagnosis of the species is given.—V.M.J.

00624 **Bayer, Thomas N.** Repetitive benthonic community in the Maquoketa Formation (Ordovician) of Minnesota: Jour. Paleontology, v. 41, no. 2, p. 417–422, illus., tables, 1967.

A fossil benthonic community in the Elgin Member of the Maquoketa Formation in Minnesota is repeated in similar proportions 49 times from the base to the top of the member. This alternation of a fossil community with barren shaly dolomites was caused by periodic shoaling and influx of terrigenous sediment. The community was decimated during these shoaling phases but reestablished itself with a return to normal depth conditions. Lateral changes in the community are demonstrated and reflect proximity of the shoreline.—Author's abstract

10407 **Bayley, R. W.; Dutton, C. E.; Lamey, C. A.; Treves, S. B.** Geology of the Menominee iron-bearing district, Dickinson County, Michigan, and Florence and Marinette Counties, Wisconsin: U.S. Geol. Survey Prof. Paper 513, 96 p., illus., tables, geol. maps, 1966.

The part of Menominee district covered by this report is underlain by lower and middle Precambrian rocks. The lower Precambrian rocks are the Carney Lake Gneiss (2.5 b.y. old) and the Quinnesec Formation, and the middle Precambrian rocks are formations of the Animikie Series. All formations are cut by metagabbro dikes and sills and locally by granite plutons (Hoskin Lake Granite) and quartz-diorite (Marinette Quartz-Diorite). The mineral ages of the granitic intrusives suggest that they are of post-Animikie age (1.6–1.8 b.y. old). The principal economic asset of the district is the Vulcan Iron-Formation; a large reserve of low-grade iron remains.—R.W.B.

Beaven, P. J. *See* Tubey, L. W. 10656

Beavers, A. H. *See* Jones, Robert L. 10361

Beavers, A. H. *See* Ahmad, N. 10400

10631 **Becker, Robert M.** The Caddo Anticline, 3S–1E, Carter County, Oklahoma, *in* Pennsylvanian of the Ardmore Basin, southern Oklahoma—Ardmore Geol. Soc., Field Conf. 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., p. 38–40, illus., 1966.

The Caddo anticline is north of Ardmore and trends northwest-southeast, and was probably formed during the Wichita-Criner orogeny. The field has produced, from six different horizons, over 3.6 million bbl of oil and 19 billion cubic feet of gas. A north-south cross section and structure contour map are included.—E.S.L.

10654 **Becker, Robert M.** Overbrook Anticline, *in* Pennsylvanian of the Ardmore Basin, southern Oklahoma—Ardmore Geol. Soc., Field Conf. 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., p. 25–28, illus., 1966.

The Overbrook anticline is southwest of Ardmore, Okla., and trends northwest-southeast. A field of four oil wells and four gas wells produces from steep-dipping Springer sand lenses in the Goddard Shale. Two east-west cross sections show a large thrust fault cutting the anticline. The fold is considered to be of Arbuckle age.—E.S.L.

00365 **Beets, D. J.; Lodder, W.** Indications for the presence of ignimbrites in the Cretaceous Washikemba formation of the isle of Bonaire, Netherlands Antilles: Koninkl. Nederlandse Akad. Wetensch. Proc., ser. B, v. 70, no. 1, p. 63–67, illus., 1967.

Two of a number of samples of volcanites of the Washikemba formation, collected by Beets in 1962, show characteristics of welded tuffs. In the collection of Pijpers (1933) only four were fresh enough to show original welded structure. In this petrographic study of the six samples, frequent occurrences of collapsed fragments often moulded around phenocrysts and rock inclusions, and deformed and welded shards indicate deposition in a hot plastic state. The presence of radiolarites show that the Washikemba formation was largely formed under marine conditions. The association of marine sediments with ignimbrites is not yet definitely explained. In the authors' opinion, the ignimbrites point to continental conditions during part of Washikemba time.—G.D.C.

10663 **Bent, R. M.; Bent-Golding, Enid L.** A complete geography of Jamaica: London and Glasgow, Collins Clear-Type Press, 128 p., illus., tables, 1966.

This book was written with the needs of senior pupils especially in mind, as well as those of tourists. The chapters include information on the geological history of Jamaica, its soils, physical features, climate, hydrogeology, earthquakes, and mineral resources.—G.D.C.

Bent-Golding, Enid L. *See* Bent, R. M. 10663

10360 **Berg, Joseph W., Jr.; Trembly, Lynn; Emilia, David A.; Hutt, Jeremy R.; King, John M.; Long, Leland Timothy; McKnight, William R.; Sarmah, Survya K.; Souders, Robert; Thiruvathukal, John V.; Vossler, Donald A.** Crustal refraction profile, Oregon coast range: Seismol. Soc. America Bull., v. 56, no. 6, p. 1357–1362, illus., table, 1966.

Seven temporary and three permanent seismograph stations recorded seismic waves to a distance of about 270 km from a 110,000-lb quarry blast detonated near Depoe Bay, Oregon. The recording stations were in a north–south line along the northern coast range of western Oregon and Washington. The traveltime data indicate an apparent shallow crustal thickness (about 16 km) for this region. The time versus distance data were not continuous beyond 130 km from the source which may have resulted from any combination of the following causes: (1) insufficient source energy; (2) lateral geological variations; and/or (3) a subcrustal negative velocity gradient.—Authors' abstract

00321 **Berman, David S.** Orientation of bradyodont dentition: Jour. Paleontology, v. 41, no. 1, p. 143–146, illus., 1967.

The teeth in the Paleozoic bradyodonts *Janassa* sp., a petalodont, and *Deltodus* sp., a cochliodont, were examined and compared. The teeth in these two subgroups seem to have been similar in orientation and function, and they resemble in these ways the teeth in the later Mesozoic to recent chimaeras. The dentitions seem to have functioned not in crushing or grinding, but rather in nipping or cutting. These resemblances suggest that the petalodonts and cochliodonts form, for the most part, a natural grouping under Bradyodonti; their dentitions may possibly represent early evolutionary stages of organization that culminated in the chimaeras.—Author's abstract

00395 **Berry, William B. N.** Comments on correlation of the North American and British Lower Ordovician: Geol. Soc. America Bull., v. 78, no. 3, p. 419–427, illus., tables, 1967.

Correlation of North American and British Lower Ordovician is a source of conflicting opinions resulting from different interpretations of the first appearance of graptolites with biserial scandent rhabdosome form in each area. The biserial scandent graptolites are considered to have originated and become established in the British Faunal Province before invading the North American province. Most of the Canadian series is correlated with the British Arenig and most of the Whiterock and Ashby are correlated with the highest part of the Arenig and the Llanvirn and Llandeillo series in Britain.—*from* Author's abstract

00615 **Berry, William B. N.** A new subspecies of *Climacograptus scalaris* (Linné?) (Hisinger) from Kentucky: Jour. Paleontology, v. 41, no. 2, p. 507–511, illus., 1967.

A new graptolite subspecies, *Climacograptus scalaris kentuckyensis*, is described from the Silurian Noland Formation of Kentucky. The Kentucky specimens are compared to other North American, British, and Swedish members of the species.—J.P.

00561 **Bhattachargi, Somdev.** Mechanics of flow differentiation in ultramafic and mafic sills: Jour. Geology, v. 75, no. 1, p. 101–112, illus., table, 1967.

The mechanical process of magmatic flow differentiation may be qualitatively important in fractionation of rock types, mineralogical zoning, and chemical differentiation. Scale models, using homogeneous and partly differentiated mixtures of solids in suspension, simulated flowage differentiation in sills 5–2,000 feet thick. Agglomeration of crystals and shear rotation produced structures geometrically similar to olivine nodules and mottled plagioclase. The volume concentration of intratelluric crystals and velocity and pressure of the flowing melt are critical in chemical and crystal fractionation. The wall effect and fluid slippage along the walls help produce crystal-free margins of sills.—F.B.

Bhattacharyya, B. K. *See* Spector, A. 10396

Bickley, Frances. *See* Mackenzie, Fred T. 00392

Bien, G. S. *See* Peterson, M. N. A. 10376

10353 **Billings, Marland P.; Rahm, David A.** Geology of the Malden Tunnel, Massachusetts: Boston Soc. Civil Engineers Jour., v. 53, no. 2, p. 116–141, illus., tables, 1966.

Malden Tunnel, part of the Spot Pond Brook Flood Control Project in Stoneham, Melrose, and Malden in eastern Massachusetts, is almost a mile long and lies 275 feet below sea level. The entire tunnel is in bedrock, the northern part in felsites of the Lynn Volcanics and the southern in argillite of the Cambridge Formation. It also crosses the Northern Boundary fault of the Boston basin, along which the volcanics have been thrust over the argillite. Fractures of various types and dikes are diversely oriented. Fracturing due to the fault and excessive flow of water were the principal problems. A geologic sketch map and sections are included.—E.S.L.

10436 **Binder, Reuben W.** The Acapulco, Mexico, earthquakes of May 11 and 19, 1962, *in* World Conf. on Earthquake Engineering, 3d, New Zealand, 1965, Proc., V. 3: Wellington, New Zealand Inst. Engineers, p. V45–V61, illus. [1966].

The importance of instrumentation of structures for recording ground motions, measuring story displacements with time, and obtaining period readings before and after earthquakes is pointed out. Velocity spectra of the East-West component of the May 11, 1962, shock are given. Displacements and story shears are cited for the 1st, 25th, and 39th stories of the Latino Americana Tower for the July 28, 1957, and May 11 and 19, 1962, shocks. The problem of recognizing (or failure to recognize) soil conditions and cumulative damage from successive earthquakes is discussed also.—*from* Author's abstract

00536 **Bjork, Philip R.** Latest Eocene vertebrates from northwestern South Dakota: Jour. Paleontology, v. 41, no. 1, p. 227–235, illus., tables, 1967.

A small collection of fossil vertebrates from the Slim Buttes Formation in Harding County, S. Dak., includes: *Lepisosteus sp., Graptemys? sp.*, a trionychid turtle, *Allognathosuchus sp. cf. A. riggsi, Epihippus intermedius, Teleodus thyboi n.sp., Colodon? cingulatus, Amynodontopsis bodei*, an agriochoerid, and a leptotraguline. This assemblage is designated the Antelope Creek local fauna and is latest Eocene, Duchesnean, in age. Associated remains of *Lepisosteus*, the turtles, *Allognathosuchus, and Amynodontopsis* indicates that a permanently flowing stream was the environment of deposition.—Author's abstract

Bjorklund, L. J. *See* Reeder, H. O. 00455

10367 **Black, Craig C.; Dawson, Mary R.** A review of late Eocene mammalian faunas from North America: Am. Jour. Sci., v. 264, no. 5, p. 321–349, illus., tables, 1966.

The late Eocene–early Oligocene was a time of major changes in the composition and character of mammalian faunas. Broadly, the transition from archaic to modern eutherian families occurred at this time. This is a review of the main North American locality in which late Eocene mammalian faunas have been found and of the general faunal developments during the late Eocene. Major changes included the disappearance of several archaic carnivore and ungulate groups, decline of perissodactyls, the late dominance of protrogomorph rodents, beginning of a major radiation of artiodactyls, and progressive changes in several orders leading toward the appearance of more advanced families either in the late Eocene or early Oligocene. Correlation of the main upper Eocene mammal-bearing localities is discussed.—Authors' abstract

00438 **Blanchard, Maxwell B.** Method for determining the density of microsize spherical particles: Geol. Soc. America Bull., v. 78, no. 3, p. 385–403, illus., tables, 1967.

Using a settling tube and microspheres of known size and density, various settling velocity equations were investigated in the laboratory to test their validity and range of applicability in terms of Reynolds number.—A.G.

10342 **Boitano, J. D.** Discussion on comparison of field and laboratory tests [paper by E. A. Miller and E. B. Hall, 1966], *in* Vane shear and cone penetration resistance testing of in-situ soils—ASTM Pacific Area Natl. Mtg., 5th, Seattle, Wash., 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 399, p. 28, 1966.

Naval facilities in the San Francisco Bay region are partially situated on bay mud, or filled ground overlying deep clay strata. Test results are presented to point up the necessity for obtaining information to prevent overestimates of field strength. One point of interest in the data can be explored further by comparing the Q shear stress with moisture content with a plot of the data. A well-defined increase in shear strength with corresponding decrease in moisture content down to about 65 percent is noted. This is followed by a sharp grouping of values and a sudden increase in measured shear strength. This is characteristic of test results reported by others on Navy projects overlying bay mud.—G.D.C.

10359 **Bold, W. A. van den.** Répartition de certains Ostracodes dans le Tertiaire des Caraïbes, *in* Symposium on micropaleontological lineages and zones . . . of the Neogene—Internat. Union Geol. Sci., Comm. Mediterranean Neogene Stratigraphy, 3d Sess., Berne, Switzerland, 1964, Proc.: Leiden, Netherlands, E. J. Brill, p. 134–139, illus., tables, 1966.

Several species groups of Ostracoda seem to have stratigraphic value in the Caribbean region. Two genera have similar species with differences in morphology by which they can be distinguished. The distribution of species that appear in the Tertiary formations of the Caribbean is tabulated; a few are discussed briefly. Three morphologic groups of *Krithe* are related to 31 foraminiferal zones; distinction of their species is mainly based on the outline of the carapace. The species of *Orionina* have differences in the marginal area and in the size and ornamentation of the carapace; correlation is made between the formations of Trinidad and the Gulf Coastal Plain. In neither genus do these characters show evolutionary trends; the stratigraphic value is only local.—G.D.C.

10495 **Bolli, Hans M.** Zonation of Cretaceous to Pliocene marine sediments based on planktonic foraminifera [with Spanish abs.]: Bol. Inf., v. 9, no. 1, 32 p., tables, 1966.

The present status of zonation of Cretaceous to Pliocene warm-water marine sediments, based on distribution of planktonic foraminifera, is reviewed and a sequence of 60 zones proposed. A first review of Cretaceous to Middle Miocene planktonic foraminiferal zones of Trinidad was given by this writer in 1959, and a zonation continuing from Middle Pliocene into the Pliocene was added in 1965 by Bolli and Bermúdez. Intermediate zones which are evidently absent or not yet recognized in Trinidad were published by other authors who subdivided some of

the existing zones further, or proposed different names for them. Some of these additions and changes are discussed in this paper. Where found justified and useful, they are incorporated in the general scheme of planktonic zones, presented in a table.—*from* Author's abstract

Bollinger, G. A. *See* Stauder, William. 10597

10621 **Bond, Gerard C.; Meade, Robert H.** Size distributions of mineral grains suspended in Chesapeake Bay and nearby coastal waters: Chesapeake Sci., v. 7, no. 4, p. 208–212, illus., 1966.

Recognizable mineral grains constituted 2 to 15 percent of the suspended matter in surface waters collected in June 1965 from Chesapeake Bay and from the offshore area between Cape Henry and Cape Hatteras. In the upper bay, the mineral grain size became progressively finer in the down-bay direction. Mineral size distributions in the middle and lower bay showed little relation to those in either the upper bay or the offshore waters. Most of the mineral grains suspended in the offshore waters (considered on a weight basis) seemed to be derived from sources other than the bay effluent.—Authors' abstract

Borch, C. C. von der. *See* Peterson, M. N. A. 10376

10464 **Borns, Harold W., Jr.; Goldthwait, Richard P.** Late-Pleistocene fluctuations of Kaskawulsh Glacier, southwestern Yukon Territory, Canada: Am. Jour. Sci., v. 264, no. 8, p. 600–619, illus., tables, 1966.

Deposits of Kaskawulsh Glacier express major climatic changes of the last 10,000 years. A great retreat, miles up valley from present terminus, occurred 12,000 to 9,000 yr ago, leaving drift on valley walls and alluvial fans. Winds added up to 8 feet of loess on these deposits and buried 9700 year-old vegetation near the present terminus. During Slims nonglacial interval weathering developed a red-yellow paleosol in this loess. In lower parts of a bog, just above the Neoglacial terminal moraine, dominant grass pollen and moss spores suggest a wetter climate than today. Just above the 3300-yr-old date in this bog, peat with sedge, spruce, and artemesia pollen show a change to a drier climate. The climatic change and reactivated outwash signal the Neoglacial advance 2600 to 3000 yr ago. Kaskawulsh reached its terminal position approximately 300 yr ago, and was there as late as 145 yr ago.—*from* Authors' abstract

00363 **Bostrom, R. C.** Water expulsion and pingo formation in a region affected by subsidence: Jour. Glaciology, v. 6, no. 46, p. 569–572, illus., 1967.

Geophysical evidence indicates that the delta of the Mackenzie River, Northwest Territories, is affected by tectonic subsidence. Pingos are of sparse occurrence in the Arctic as a whole but they occur in hundreds in the Mackenzie River delta. In a region of subsidence, as recent sediments pass through the base of permafrost, compaction becomes possible. The resulting water expulsion produces an artesian head responsible for building pingos.—Author's abstract

Bowen, Zeddie Paul. *See* Hoar, Florence Grosvenor. 00557

00386 **Bower, C. A.; Hatcher, J. T.** Adsorption of fluoride by soils and minerals: Soil Science, v. 103, no. 3, p. 151–154, table, 1967.

Gibbsite, kaolinite, halloysite, precipitated $Al(OH)_3$, and all soils studied adsorbed significant amounts of fluorine with release of OH^-. Goethite, bentonite, and vermiculite adsorbed only traces of F. The similar adsorption of dehydrated halloysite, compared with the very high F adsorption capacity of precipitated $Al(OH)_3$, suggests that F adsorption at low concentrations occurs primarily by exchange with OH of the $Al(OH)_3$ rather than with the crystal lattice OH of clay minerals. If a soil having high permeability and high F adsorption capacity were available, it might be practical to remove the excess F from water for municipal use by adsorption on soil in a system such as used for ground-water recharge.—J.W.H.

Bowsher, Arthur L. *See* Walthall, Bennie H. 10653

00358 **Boyle, J. R.; Voight, G. K.; Sawhney, B. L.** Biotite flakes—Alteration by chemical and biological treatment: Science, v. 155, no. 3759, p. 193–195, illus., 1967.

Biotite alteration under acid conditions proceeds differently from the generally accepted pathway of transformation to vermiculite in which hydrated cations cause interlayer expansion, resulting in a dark-colored peripheral band on mica particles. Acid solutions of synthetic or biologic origin remove octahedral ions, leaving a fragile matrix of amorphous material.—Authors' abstract

00343 **Brabb, Earl E.** Stratigraphy of the Cambrian and Ordovician rocks of east-central Alaska: U.S. Geol. Survey Prof. Paper 559-A, p. A1–A30, illus., 1967.

Four new formation names are established for the westernmost known exposures of Cambrian sedimentary rocks in North America. Facies maps indicate that the Jones Ridge area was a shoal or reef during part of the early Paleozoic and that the adjoining area was a turbulent marine shelf. Rapid changes in facies, the possibility of reeflike sedimentation, and the occurrence of bitumen and other organic matter in the rocks make the lower Paleozoic rocks attractive for petroleum exploration.—E.E.B.

Brackley, R. A. *See* Sammel, E. Z. 10545

00500 **Branson, Carl C.** *Caryocaris* removed from Oklahoma faunal list: Oklahoma Geology Notes, v. 27, no. 3, p. 44, 1967.

10618 **Brew, D. A.** (compiler). Geological map of southeastern Alaska: Montreal, Quebec, Canadian Inst. Mining and Metallurgy, scale 1:1,267,200, 1966.

Bricker, Owen P. *See* Mackenzie, Fred T. 00392

10442 **Bridge, Thomas E.** Bredigite, larnite and γ dicalcium silicates from Marble Canyon: Am. Mineralogist, v. 51, nos. 11–12, p. 1766–1774, illus., tables, 1966.

The α' (bredigite), β (larnite) and γ (unnamed) forms of dicalcium silicate (Ca_2SiO_4) occur together in the contact zone around a syenite–monzonite intrusion in Marble Canyon [Culberson County, Texas]. Bredigite, larnite and γ have consistent crystallographic orientations when they occur together. These relationships reflect the crystallographic direction in which the reorganization occurs when transformation from one form to another takes place.—Author's abstract

Bright, Norman F. H. *See* Coats, A. W. 10626

10347 **Bristol, Calvert C.** Geology of the Issett Lake area (west half), Granville Lake Mining Division, Manitoba: Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 63-4, 26 p., illus., table, geol. map, 1966.

The map-area is part of the Churchill area map block. A five-fold division of the Precambrian rocks is used: the Wasekwan Series, Pre-Sickle intrusive group, Sickle Series, Kisseynew-type rocks, and Post-Sickle intrusive group. These formations are covered by glacial deposits in the areas of lower altitude. Most primary rock structures have been erased by strong secondary foliation and lineation; banding may reflect either sedimentary layers or differences between paragneisses and flows or sills; and joints may be either primary or secondary. The joint systems are analyzed statistically. Strong foliation is developed in the meta-sedimentary rocks of the whole region. There is no mining activity within the map-area.—E.S.L.

10532 **Brock, V. E.; Chamberlain, Theodore; Helfrich, P.** An ecological and geological reconnaissance of western Oahu, Hawaii principally by means of the deep-diving submarine *Asherah* [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 78, 1966.

Brown, D. A. *See* Irving, E. 10479

10547 **Brown, James S.** Formation evaluation in heavy oil sands, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. B1–B14, illus., table, 1966.

In the Chauvin, Wainwright, and Lloydminster areas, Alberta and Saskatchewan, the principal heavy oil reservoir is the Sparky sand surrounded by channels of shale. Correlation is more difficult in the Lloydminster area because sand distribution is more complex, and reservoir detection more difficult at Wainwright and Chauvin because sands are thin and apparent resistivities low; at Lloydminster sands are thick and apparent resistivities high. At Wainwright and Chauvin, a resistivity log, porosity log, and often a drill stem test are necessary for a decision to set pipe; at Lloydminster, only an electric log is required. Productivity varies probably due to changes in permeability and oil viscosity. As these changes are not detected by electric logs, practice is to determine productivity by testing after setting pipe. Transmissibility, from drill-stem test data, may provide an earlier means of estimation.—E.S.L.

Brown, K. B. *See* Hurst, F. J. 10418

00481 **Brown, Randall E.** Hydrologic interarea relationships as indicated by rising heads in confined aquifers, Pasco Basin, Washington [abs.]: Northwest Sci., v. 41, no. 1, p. 46, 1967.

10576 **Bruun, P. M.** By-passing and backpassing with special reference to conditions in Florida, Chap. 24 *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 561–626, illus., tables, 1966.

By-passing by natural action is mentioned with special reference to Florida Inlets and to some other inlets in the United States and abroad. By-passing plants—partly because of the tidal flow which discharges material in the ocean and in the bay and partly as a result of the rise of sea level—will not be able to solve more than a certain part of a beach erosion problem, and replenishment by sand from other sources is indispensable. Material may be brought to shore by "backpassing" using an offshore scraper or by a special hydraulic dredge. If the borrow area is located close to shore, the question arises of whether the borrow pit will fill up again by material from further offshore, material from the sides or from material dragged out by waves from the beach. The report describes briefly tests on Jupiter Island. The success of this operation is checked by fluorescent tracers.—*from* Author's abstract

Bryant, William. *See* Antoine, John. 00361

Brydon, J. E. *See* Singh, S. Shah. 00387

10530 **Buffington, Edwin C.; Scholl, David W.; Hopkins, David M.** Sub-bottom acoustic reflection transects of the Bering slope and shelf and Aleutian basin near the International Date Line [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 73–74, 1966.

10611 **Burger, Ann M.; Rexroad, Carl B.; Schneider, Allan F.; Shaver, Robert H.** Excursions in Indiana geology—Assoc. Am. State Geologists, 58th Mtg., 1966: Indiana Geol. Survey Guidebook 12, 71 p., illus., 1966.

The guidebook contains road logs for two field trips in south-central Indiana and two papers; the paper by L. F. Rooney is cited separately. Three geologic sketch maps, three glacial maps, and five sections and charts are included.—E.S.L.

Burton, Lynn R. *See* Logan, Malcolm H. 00340

Busby, Roswell F. *See* Rucker, James B. 00445

00433 **Cadle, R. D.; Wartburg, A. F.; Frank, E. R.; Lodge, J. P., Jr.** Particles in volcanic fume: Nature, v. 213, no. 5076, p. 581, illus., 1967.

Volcanic fume emitted by Halemaumau, the main vent of Kilauea Volcano in Hawaii, in 1965 was collected and the particles analyzed. Ammonium sulfate was identified. Ammonia has not previously been reported in the fume from Kilauea, although it is known to be emitted by other volcanoes. The possibility of contamination with atmospheric ammonia cannot be dismissed. Additional investigations, especially of the fume above molten lava, are needed to establish whether ammonium sulfate is indeed an important component of the fume of erupting volcanoes. If so, enormous amounts must at times be emitted into the atmosphere.—D.B.V.

10629 **Cadle, Richard D.** Particles in the atmosphere and space: New York, Reinhold Publishing Corporation, 226 p., illus., tables, 1966.

This book describes the nature, sources, and behavior of particles in the Earth's atmosphere, on the surface of the Moon, on the surfaces or in the atmospheres of other planets, and elsewhere in space. Man-made as well as natural aerosol particles are included in the discussion, because they are similar in respect to size and composition. Sources include volcanoes, dust storms, biological material, and meteoric dust, as well as sea salt, forest fire ash, and pollution.—G.D.C.

Caldwell, R. L. *See* Baldwin, W. F. 10548

00322 **Cameron, Barry.** Oldest carnivorous gastropod borings, found in Trentonian (Middle Ordovician) brachiopods: Jour. Paleontology, v. 41, no. 1, p. 147–150, illus., 1967.

Nine carnivorous gastropod borings were found in Trentonian (Middle Ordovician) brachiopods (*Dalmanella, Sowerbyella, and Hesperorthis*) from limestones in New York and Michigan. These are probably the oldest carnivorous snail borings yet described. Criteria are reviewed for determining (1) whether a hole in a shell is a snail boring and (2) which of the associated gastropods was the carnivore. The caenogastropod *Subulites* was probably the carnivorous snail, and specimens of it were found in the same bed with a snail-bored brachiopod.—Author's abstract

00410 **Cameron, Barry.** Fossilization of an ancient (Devonian) soft-bodied worm: Science, v. 155, no. 3767, p. 1246–1248, illus., 1967.

A shell-boring polychaete worm was found in the Marcellus Formation of central New York, replaced by limonite-goethite, probably pseudomorphic after pyrite. External structures such as a prostomium, anterior tentacle-like palps, peristomial cirrim parapodia, setae bundles of the parapodia, and dorsal cirri of the parapodia are preserved; the worm resembles living members of the Spionidae in form and habit. This discovery extends the known range of this family back about 365 m.y. to the Devonian period.—D.B.V.

00482 **Campbell, Charles D.** Metamorphism of some Kettle Range rocks, Ferry County, Washington [abs.]: Northwest Sci., v. 41, no. 1, p. 56, 1967.

Campbell, Finley A. *See* Radcliffe, Dennis. 10446

Campbell, John M. *See* Helander, Donald P. 10565

00569 **Canada Geological Survey.** Aeromagnetic map, Sheet 75 O/2, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3551, scale 1:63,360, 1967.

00570 **Canada Geological Survey.** Aeromagnetic map, Williams Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3552, scale 1:63,360, 1967.

00571 **Canada Geological Survey.** Aeromagnetic map, Tyrrell Lake West, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3553, scale 1:63,360, 1967.

00572 **Canada Geological Survey.** Aeromagnetic map, Douglas Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3554, scale 1:63,360, 1967.

00573 **Canada Geological Survey.** Aeromagnetic map, Smart Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3555, scale 1:63,360, 1967.

00574 **Canada Geological Survey.** Aeromagnetic map, Radford Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3557, scale 1:63,360, 1967.

00575 **Canada Geological Survey.** Aeromagnetic map, Ptarmigan Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3558, scale 1:63,360, 1967.

00576 **Canada Geological Survey.** Aeromagnetic map, Hanbury Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3561, scale 1:63,360, 1967.

00577 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 G/1, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3596, scale 1:63,360, 1967.

00578 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 H/4, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3597, scale 1:63,360, 1967.

00579 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 H/3, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3598, scale 1:63,360, 1967.

00580 **Canada Geological Survey.** Aeromagnetic map, Sheet 76 H/2, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 3599, scale 1:63,360, 1967.

00581 **Canada Geological Survey.** Aeromagnetic map, Lamb Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4242, scale 1:63,360, 1967.

00582 **Canada Geological Survey.** Aeromagnetic map, Moose Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4243, scale 1:63,360, 1967.

00583 **Canada Geological Survey.** Aeromagnetic map, Connolly Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4248, scale 1:63,360, 1967.

00584 **Canada Geological Survey.** Aeromagnetic map, Red Earth Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4249, scale 1:63,360, 1967.

00585 **Canada Geological Survey.** Aeromagnetic map, Landry Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4250, scale 1:63,360, 1967.

00586 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 F/6, Manitoba: Canada Geol. Survey Geophysics Paper 4253, scale 1:63,360, 1967.

00587 **Canada Geological Survey.** Aeromagnetic map, Pasquia Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4254, scale 1:63,360, 1967.

00588 **Canada Geological Survey.** Aeromagnetic map, The Pas, Manitoba: Canada Geol. Survey Geophysics Paper 4255, scale 1:63,360, 1967.

00589 **Canada Geological Survey.** Aeromagnetic map, Chemong Creek, Manitoba–Saskatchewan: Canada Geol. Survey Geophysics Paper 4256, scale 1:63,360, 1967.

00590 **Canada Geological Survey.** Aeromagnetic map, Turnberry, Manitoba–Saskatchewan: Canada Geol. Survey Geophysics Paper 4257, scale 1:63,360, 1967.

00591 **Canada Geological Survey.** Aeromagnetic map, Culdesac Lake, Manitoba–Saskatchewan: Canada Geol. Survey Geophysics Paper 4258, scale 1:63,360, 1967.

00592 **Canada Geological Survey.** Aeromagnetic map, Barrier Lake, Manitoba–Saskatchewan: Canada Geol. Survey Geophysics Paper 4259, scale 1:63,360, 1967.

00593 **Canada Geological Survey.** Aeromagnetic map, Donjek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4287, scale 1:63,360, 1967.

00594 **Canada Geological Survey.** Aeromagnetic map, North Kluane, Yukon Territory: Canada Geol. Survey Geophysics Paper 4288, scale 1:63,360, 1967.

00595 **Canada Geological Survey.** Aeromagnetic map, Mackinnon Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4289, scale 1:63,360, 1967.

00596 **Canada Geological Survey.** Aeromagnetic map, Wellesley Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 4290, scale 1:63,360, 1967.

00597 **Canada Geological Survey.** Aeromagnetic map, Tom Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4291, scale 1:63,360, 1967.

00598 **Canada Geological Survey.** Aeromagnetic map, Carlisle Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4292, scale 1:63,360, 1967.

00599 **Canada Geological Survey.** Aeromagnetic map, Los Angeles Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4293, scale 1:63,360, 1967.

00600 **Canada Geological Survey.** Aeromagnetic map, Excelsior Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4294, scale 1:63,360, 1967.

00601 **Canada Geological Survey.** Aeromagnetic map, Ogilvie, Yukon Territory: Canada Geol. Survey Geophysics Paper 4295, scale 1:63,360, 1967.

00602 **Canada Geological Survey.** Aeromagnetic map, Garner Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4296, scale 1:63,360, 1967.

00603 **Canada Geological Survey.** Aeromagnetic map, Swede Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 4297, scale 1:63,360, 1967.

00604 **Canada Geological Survey.** Aeromagnetic map, Fifteenmile River, Yukon Territory: Canada Geol. Survey Geophysics Papr 4298, scale 1:63,360, 1967.

00415 **Carey, Walter C.** Nomenclature for bed forms in alluvial channels—Discussion [of paper 4823, by ASCE Task Force, 1966]: Am. Soc. Civil Engineers Proc., v. 93, Jour. Hydraulics Div., no. HY 2, p. 72–74, 1967.

One omission noted in this paper (ibid., v. 92, no. HY 3, p. 51–64, 1966) concerns special triangular "bend" dunes, found by this writer at low and medium stages when making thalweg profiles on the lower Mississippi River. Prototype profiles such as these could throw light on discontinuities in rating curves reported by various observers. Depth finders might be improved to supply additional river-bed geological data, particularly over crossings and around bends. Thalweg profiles may also offer means of studying sediment movements not detectable by present sampling equipment and techniques.—G.D.C.

00389 **Carlson, R. M.; Overstreet, Roy.** A study of the ion exchange behavior of the alkaline earth metals: Soil Science, v. 103, no. 3, p. 213–218, illus., table, 1967.

Ion exchange equilibrium experiments were performed that seem to demonstrate the adsorption of incompletely dissociated hydroxides of Mg, Ca, Sr, and Ba by bentonite. It appears that significant amounts of these ions are absorbed in equilibrium systems with pH's as low as 7. Thus in considering the cation-exchange equilibrium of soils with neutral or alkaline reaction, account must be taken of the possible existence of these incompletely dissociated hydroxides in the exchanger phase. These results also raise some question about the advisability of using the alkaline earth metal cations as index ions for CEC determinations.—J.W.H.

00443 **Carpenter, Robert H.; Hale, Robin C.** Nickeliferous soils and stream sediments associated with peridotites near Democrat, North Carolina: Southeastern Geology, v. 8, no. 1, p. 9–18, illus., 1967.

Two analytical procedures for nickel in the vicinity of two peridotites near Democrat, N. C., utilize dimethlglyoxime but differ in the method of sample digestion; one is an "available", the other a "total" procedure. Lateritic soils on peridotite analyzed by the "total" procedure contain 1,000 to 10,000 ppm nickel, whereas soils over adjacent country rocks had less than 30 ppm. The "available" nickel concentration in soils over peridotite ranges from 10 to 25 ppm, and adjacent soils less than 5 ppm. Values for stream sediments derived from sources other than peridotite are less than the limit of detection of the "total" procedure; downstream from the peridotites anomalies extend from 1,000 to 4,000 ppm. The "available" values are low and show poor correlation with those determined by "total" procedure.—G.D.C.

00442 **Carrington, Thomas J.; Wigley, Perry.** Redefinition of the Hillabee Schist, Alabama: Southeastern Geology, v. 8, no. 1, p. 19–31, illus., tables, 1967.

Field studies and microscopic, X-ray and chemical analyses, indicate division of the Hillabee Schist into an altered, basic igneous intrusion, and altered metasediments of the adjacent Talladega and Ashland Groups. It is suggested that "Hillabee Sole Injection" designate the basic igneous rocks within the green schist belt, and that the flanking metasediments be renamed as altered facies of the Talladega and Ashland Groups. The Hillabee Sole Injection has a preponderance of hydrous ferro-magnesian minerals plus plagioclase, chemically is low in silica and high in calcium, magnesium, and iron. The altered metasediments have a preponderance of quartz plus minor quantities of feldspar and hydrous ferro magnesian minerals, and are chemically high in silica and low in calcium, magnesium and iron. Textural differences are also distinctive.—G.D.C.

Carroll, Robert L. *See* Baird, Donald. 00314

00532 **Carroll, Robert L.** Labyrinthodonts from the Joggins formation: Jour. Paleontology, v. 41, no. 1, p. 111–142, illus., 1967.

Three species of labyrinthodonts are recognized from the Joggins formation, Westphalian B, of Joggins, Nova Scotia: *Dendrerpeton acadianum* Owen, a rhachitome; *Calligenethlon watsoni* Steen, an embolomere; and *"Baphetes" minor* Dawson, probably an embolomere. The first two species come from a predominantly terrestrial environment, the latter probably from an aquatic environment. Other labyrinthodont species named in the past represent variants within populations.—*from* Author's abstract

00560 **Carson, M. A.** The magnitude of variability in samples of certain geomorphic characteristics drawn from valley-side slopes: Jour. Geology, v. 75, no. 1, p. 93–100, illus., tables, 1967.

The optimum sample size required in quantitative geomorphic studies is a function of three variables: the amount of information wanted about the population from which the sample came, the amount of confidence desired in the conclusions, and the variability within the individual population. The last of these is usually unknown and a preliminary investigation is sometimes necessary to estimate variability prior to the main research.—A.T.M.

Chakravartty, S. C. *See* Hedgecock, N. E. 10632

00379 **Chamberlain, J. A.** Sulfides in the Muskox intrusion: Canadian Jour. Earth Sci., v. 4, no. 1, p. 105–153, illus., tables, 1967.

The Muskox intrusion is a layered, ultramafic pluton in northern Canada. Sulfide phases are concentrated along its margins and in chromite-rich horizons within its central layers, and disseminated elsewhere except in its almost barren core. Primary sulfide assemblages in layered series are nickel-rich at base, copper-rich at intermediate levels, and iron-rich near roof; in marginal zones this order is inverted. Stages of formation appear to include replacement of host rocks at below 675°C and concentration by desulfidization of magma during cooling; subsequent serpentinization with progressive loss of oxygen; and weathering in peripheral zones where H_2S reacted with primary sulfides, oxides, and silicates. In the Muskox feeder dike and diabase dikes of the area dissemination was uniform; sulfides crystallized in situ with no zoning.—G.D.C.

Chamberlain, Theodore. *See* Brock, V. E. 10532

Chamberlain, Theodore K. *See* Stearns, Harold T. 00460

00384 **Chang, Yi-Maw.** Accuracy of fossil percentage estimation: Jour. Paleontology, v. 41, no. 2, p. 500–502, illus., 1967.

It is assumed that variability in the estimation of the percentage of a species in a representative but partial faunal sample is due to the probability associated with random sampling. The error of the estimated percentage is inversely proportional to the square root of the studied population number, and thus the appearance of a species and the variability of its percentage are dependent on the population number. Before interpretation of percentage estimations is made the appropriate standard deviation for the study should be calculated.—J.F.M.

10422 **Chase, A. B.; Osmer, Judith A.** Growth of single crystals of ZrO_2 and HfO_2 from PbF_2: Am. Mineralogist, v. 51, nos. 11–12, p. 1808–1811, illus., tables, 1966.

ZrO_2–HfO_2 crystals up to 5 mm were grown in a PbF_2 melt at temperatures between 1250° and 800°C. Most of the ZrO_2 crystals exhibited (100) twinning with each crystal being composed of two or three twin-related individuals with the composition plane generally bisecting the crystal. The HfO_2 crystals are rarely twinned, but when they are they show (100) twinning. The crystals are colorless and appear to be of good optical quality.—B.S.H.

10519 **Chave, Keith E.** Interactions between surface seawater and suspended mineral phases [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 5], p. 9, 1966.

10380 **Chayes, Felix.** Alkaline and subalkaline basalts: Am. Jour. Sci., v. 264, no. 2, p. 128–145, illus., tables, 1966.

Most Cenozoic basic volcanics can be classed as alkaline or subalkaline depending on whether their norms contain ne or Q. Probably less than 25 percent of all analyses of Cenozoic basic volcanics yield norms containing neither ne nor Q. Such analyses fall in the normative ternary di′-hy′-ol′, and if they were classified by means of a discriminant based upon any pair of these three variables natural groupings would usually be preserved. In view of its recent history and development, the term tholeiite, particularly in its present broad connotation, should be abandoned. Alternatively, as suggested by Jung (1958), it should be strictly confined to rocks similar to those of the type locality.—Author's abstract

10615 **Cheatum, E. P.; Allen, Don.** Ecological significance of the fossil fresh-water and land shells from the Domebo mammoth kill site, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie-Plains: Mus. Great Plains Contr., no. 1, p. 36–43, illus., tables, 1966.

Mollusks of the lower member of the late Pleistocene Domebo Formation were studied from three localities at the Domebo mammoth kill site, Okla., and one locality about 200 yards downstream. One species of sphaerid pelecypod, eight fresh-water gastropods, and 21 land gastropods are listed, with notes on present distribution and ecology. Assuming that the preferred habitats of the species were the same in late Pleistocene as today, at least seven preferred habitats are represented among the 30 species. In all four localities, the highest percentage represents species preferring shallow, quiet water and the lowest represents drought-tolerant species. These data suggest that the site was a marsh with luxuriant vegetation, surrounded by sparse to dense woodland, with climate somewhat milder and more humid than today.—V.M.J.

00332 **Childs, Orlo E.** Progress through service: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 311–315, 1967.

This is the presidential address for the 51st annual meeting of the American Association of Petroleum Geologists at St. Louis, Mo., April 1966. It reviews the general contributions of the Society to the leadership and development of energy economy of the United States in the past and its responsibilities to the future.—V.S.N.

00346 **Christiansen, E. A.** Preglacial valleys in southern Saskatchewan: Saskatchewan Research Council Geology Div. Map 3, 2d edition, scale 1:1,520,640, text, 1967; originally published 1965.

The abstract for the first edition of this map appears in the July 1966 issue of Abstracts of North American Geology.—M.C.M.

Chronic, John. *See* Baars, D. L. 00369

10412 **Clay, C. S.** Use of arrays for acoustic transmission in a noisy ocean: Rev. Geophysics, v. 4, no. 4, p. 475–507, illus., 1966.

Matched array filter techniques can be applied to signal transmissions in the ocean. Coherent addition of information in the different modes can give improvement in signal-to-noise ratio. Merits of array filters to operate on either K_m or ϕ_m have been compared; it appears that horizontal array filters, i.e., K_m filters, are less critical in design and installation. Response of a vertical array to distant noise sources is different from that of a horizontal array. The signal-to-noise ratio for a horizontal area array would be larger than for a vertical array with same number of transducers. A transmission system in which modes are added coherently has another property which might make it possible to use matched signal techniques to transmit signals selectively from source to a particular receiver, or matched filters could receive transmission from a particular source.—*from* Author's conclusions

Clem, Richard. *See* Scott, W. Frank. 00493

10637 **Cline, L. M.** Late Paleozoic rocks of Ouachita Mountains, a flysch facies, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 91–111, illus., 1966.

In the central Ouachitas of Oklahoma, late Paleozoic rocks include about 22,000 feet of shales and sandstones in the Stanley-Jackfork-Johns Valley-Atoka sequence. The sandstones are turbidites and together with the interbedded dark shales exhibit all of the diagnostic sedimentary characteristics of a flysch facies. These features, characteristic of the classical Alps and Carpathians, are summarized; nowhere in Europe are there better examples than in the Jackfork and Atoka sequences. Igneous rocks ordinarily are not an important part of flysch, but there are several tuffs in the Stanley Group. Slumps, slides, and other gravity induced features, including exotic rock masses, are common in the Ouachitas, but not numerous; fossiliferous beds are scarce except for siliceous shales. The depositional environment is interpreted as a deep trough.—G.D.C.

00448 **Cloud, Preston E., Jr.** Geology and bauxite deposits of the Rock Run and Goshen Valley areas, northeast Alabama: U.S. Geol. Survey Bull. 1199-N, p. N1-N74, illus., tables, geol. map, 1967.

Principal stratigraphic units mapped in the 58-sq mi area are formations in the Knox Group of Late Cambrian and Early Ordovician age. Structurally the area is part of the complex Coosa thrust sheet. Deposits of bauxite and kaolin are underlain by carbonate rocks of the Knox Group. The bauxite and kaolin are considered to be remnants of formerly extensive deposits of probable early Tertiary age preserved in ancient sinkholes. The deposits are in small pockets surrounded by residuum from the enclosing carbonate rocks. Reserves revealed by drilling are estimated at about 624,000 long tons of bauxite and 752,000 long tons of kaolin.—A.C.S.

10626 **Coats, A. W.; Bright, Norman F. H.** The kinetics of the thermal decomposition of pyrite: Canadian Jour. Chemistry, v. 44, no. 10, p. 1191-1195, 1966.

The kinetics of thermal decomposition of purified pyrite to pyrrhotite and sulfur in a dynamic argon atmosphere, over the temperature range 600 to 653°C, were observed by the rate of weight loss as indicated by a quartz spring balance and also by the rate of progression of the pyrite/pyrrhotite interface into a cylindrical, compressed polycrystalline pellet. The temperature coefficient of the reaction was found to be 69.5±5.9, and 64.7±3.3, and 66.9±5.1 kcal $mole^{-1}$. The pyrite/pyrrhotite interface was found to progress at a linear rate into the pellet at a given temperature; equations were derived to express variation of reaction rate with temperature. Attempts to follow the early nucleation stage of decomposition, using massive mineral crystals, proved unsuccessful.—*from* Authors' abstract

10424 **Cohen, Lewis H.; Ribbe, Paul H.** Magnesium phosphate mineral replacement at Mono Lake, California: Am. Mineralogist, v. 51, nos. 11-12, p. 1755-1765, illus., tables, 1966.

A new and unique occurrence of newberyite, $MgHPO_4 \cdot 3H_2O$, and monetite, $CaHPO_4$, is reported from Paoha Island, Mono Lake, Calif. The newberyite is a decomposition product of struvite, $MgNH_4PO_4 \cdot 6H_2O$, which once formed as large crystals (often twinned) in or immediately below a guano deposit; the original struvite morphology has been preserved by a thin, dense veneer of monetite. The Mono Lake newberyite is orthorhombic (Pbca) with cell constants $a = 10.203 \pm 0.005$; $b = 10.679 \pm 0.005$; $c = 10.018 \pm 0.006$A. An indexed X-ray powder pattern and new data on the dehydration of newberyite is discussed in light of its known aqueous chemistry.—Authors' abstract

Cohen, Lewis H. *See* Adams, Leason H. 10462

Coleman, N. T. *See* McNeal, B. L. 10443

10420 **Coleman, R. G.; Ross, D. R.; Meyrowitz, R.** Zellerite and metazellerite, new uranyl carbonates: Am. Mineralogist, v. 51, nos. 11-12, p. 1567-1578, illus., tables, 1966.

Zellerite, a new hydrous calcium uranyl carbonate, occurs as needle-like orthorhombic crystals on oxidized uranium ore at the Lucky Mc mine, Fremont County, Wyo. The mineral is lemon yellow with a dull luster and no cleavage. Measured specific gravity is 3.25 and optical properties are: α 1.536, β 1.559, γ 1.697, biaxial (+), $2V = 30$-$40°$, Z = c, dispersion weak v>r; pleochroism: Z = light yellow, Y = colorless, X = colorless. On partial dehydration, metazellerite, a probable metacalcium uranyl dicarbonate is produced. Single crystal X-ray powder data of both hydrated and dehydrated material give unit cell parameters which indicate a change in volume corresponding to a possible loss of 8 to 10 water molecules upon dehydration.—B.S.H.

10444 **Collett, L. S.** Airborne resistivity surveys useful for overburden tests, *in* Contributions to geological exploration in Canada: Canada Geol. Survey Paper 66-42, p. 24-25, 1966.

Since 1950 airborne electromagnetic surveys have developed extensively and are now applied to soil mapping, trafficability of soils, and ice thickness measurements. In 1965 the Geological Survey of Canada began study of electrical properties of soils and surficial deposits to determine if any E.M. method could differentiate between surficial deposits with the possibility of delineating buried aquifers. Although the airborne surveys do not give apparent resistivity values as measured by ground DC resistivity surveys, amplitudes of the transient responses delineate areas of different resistivity contrasts, and the saving in time is considerable. From experience gained in this study it is hoped that techniques can be developed for the conductive overburden problem in mineral exploration in the Precambrian Shield and to aid the ground-water hydrologist and Pleistocene geologist in mapping programs.—M.C.M.

00553 **Colton, George W.** Late Devonian current directions in western New York with special reference to *Fucoides graphica*: Jour. Geology, v. 75, no. 1, p. 11–22, illus., 1967.

The lower Upper Devonian sequence consists largely of evenly stratified alternating layers of gray shale, black shale, and gray siltstone, which were derived from the east and southeast and deposited in an arm of a shallow epicontinental sea. Groove, flute, bounce, brush, and prod casts, and current ripple marks are associated with the deposition of silt and sand, presumably by turbidity currents; these structures are preferentially oriented east–west, parallel to currents that flowed at an angle to the arm of the sea. Numerous *Fucoides graphica* (semicylindrical cast 3/4 to 3 1/2 in. long and probably the remnant of a fecal pellet of a fish), and plant fragments are associated with deposition of fine-grained mud; these are preferentially oriented northeast–southwest, indicating normal marine currents that flowed parallel to the axis of the arm of the sea.—V.E.S.

00620 **Condie, Kent C.** Composition of the ancient Nortn American crust: Science, v. 155, no. 3675, p. 1013–1015, tables, 1967.

Geochemical studies of Wyoming Precambrian graywackes derived from continental crust older than 3.2×10^9 years indicate that their source area was at least as highly differentiated as most younger Precambrian crust. The composition of this early crust (approximately that of calcium-rich granite) is not unlike that of the 2.5 to 3.2×10^9 year old North American crust. Limited geochemical data suggest that the composition of North America may not have changed significantly during the last 3.0 to 3.5×10^9 years.—Author's abstract

10481 **Cook, Kenneth L.; Mudgett, Philip M.** Regional gravity survey of the Mineral, San Francisco, Beaver, and northern Wah Wah Mountains region, in Beaver and Millard Counties, Utah [abs.]: Utah Acad. Sci., Arts and Letters Proc., v. 43, pt. 2, p. 62, 1966.

Cooper, B. Land, Jr. *See* Jones, C. T. 00374

Corey, R. B. *See* Petersen, G. W. 10363

00554 **Craig, Gordon Y.** Size-frequency distributions of living and dead populations of pelecypods from Bimini, Bahamas, B.W.I.: Jour. Geology, v. 75, no. 1, p. 34–45, illus., 1967.

The size-frequency distributions of living and dead populations of *Lucina pensylvanica, Divaricella quadrisulcata, Codakia orbicularis, Glycymeris* sp., and a dead population of *Tellina radiata* are examined. It is shown that the form of the size-frequency distribution of *in situ* populations depends on the interplay between the growth rate of the shell and the mortality rate.—A.T.M.

10497 **Crawford, María Luisa.** Composition of plagioclase and associated minerals in some schists from Vermont, U.S.A., and South Westland, New Zealand, with inferences about peristerite solvus: Contr. Mineralogy and Petrology, v. 13, no. 3, p. 269–294, illus., tables, 1966.

Two suites of regionally metamorphosed semi-pelitic schists were studied, as to the paragenesis of low temperature plagioclase and nature of the peristerite solvus at the temperatures and pressures of their formation: one suite was from the Gile Mountain Formation in eastern Vermont, the other from the Alpine schists along the Haast River, New Zealand. Plagioclase and associated mineral compositions were determined by electron-probe microanalysis. The variation with increasing grade in Vermont schists suggests an asymmetrical peristerite solvus with a near vertical albite-rich side and a sloping oligoclase-rich side; the top of the solvus appeared to lie slightly above the temperature expressed by the almandine isograd in these schists. In New Zealand rocks a lower geothermal gradient is suggested; in both suites the hypothesis that plagioclase relations represent equilibrium is supported.—G.D.C.

10666 **Crenshaw, A. B.; Sherwood, W. C.; Ern, E. H.** Surface charges on selected highway aggregates [abs.], *in* Virginia Acad. Sci. Proc. 1965-66: Virginia Jour. Sci., new ser., v. 17, no. 4, p. 316, 1966.

00562 **Cressman, Earle R.** Geologic map of the Georgetown quadrangle, Scott and Fayette Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-605, scale 1:24,000, section, text, 1967.

The Grier Limestone Member of the Lexington Limestone is quarried near Georgetown for road metal and concrete aggregate; many small abandoned quarries are present in both the Grier and Tanglewood Limestone Members. Barite was mined on a small scale in the early 1900's; some veins were noted during mapping. The map sheet includes a fossil collection list and a generalized diagram showing stratigraphic relations of mapped units in the Lexington Limestone and the Clays Ferry Formation.—M.C.M.

10608 **Crickmay, C. H.** Devonian time in western Canada: Calgary, Alberta, E. de Mille Books, 38 p., tables, 1966.

The major concern in oil exploration in western Canada is how to correlate the Devonian System. Its time divisions can be obtained only by comparing a number of local zones, integrating their faunal sequences to find hidden gaps, and relating conclusions to better known New York and European evidence. In the past stratigraphic commissions and a code of rules have substituted for scientific keenness and individual exertion. Terms erected about 1900, such as biochron and hemera, are reviewed. The definition for the latter is restated as "the postulated duration of a specific fauna and its bionic equilibrium," making it of value in time correlation. A hemeral scheme for the Devonian of western Canada is constructed, with each of various local sections summarized in tabular form.—G.D.C.

00475 **Crompton, A. W.; Jenkins, F. A., Jr.** American Jurassic symmetrodonts and Rhaetic "pantotheres": Science, v. 155, no. 3765, p. 1006-1009, illus., 1967.

The molar morphology of the symmetrodonts *Tinodon* and *Eurylambda* from the Late Jurassic of North America is virtually identical to that of so-called "pantotheres" from the Rhaetic of Wales. Therefore, a primitive symmetrodont molar pattern was probably present in the phylogeny of pantotherian and tribosphenic molars. Occlusion of *Tinodon* and *Eurylambda* produced complex wear facets unlike the simple trigon-trigonid shear surfaces of *Spalacotherium* and *Peralestes*.—Authors' abstract

00331 **Croneis, Carey.** Geology and the A.A.P.G.—Reconsidered: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 316-324, table, 1967.

This is the keynote address for the 51st annual meeting of the American Association of Petroleum Geologists at St. Louis, Mo., April 1966, and emphasizes the importance of the geologist to the development of energy sources in the nation and the necessity for improving the national standing of the science. A brief review is given of the history of the American Association of Petroleum Geologists with emphasis on the outstanding geologists involved, and on problems created by increasing specialization, decrease in numbers of students specializing in geology, and poor hiring and firing practices of major petroleum companies. It is suggested

that the American Association of Petroleum Geologists should alter its name to become the American Association of Geologists and eventually the International Association of Geologists.—V.S.N.

00518 **Cronin, James G.; Wilson, Clyde A.** Ground water in the flood-plain alluvium of the Brazos River, Whitney Dam to vicinity of Richmond, Texas: Texas Water Devel. Board Rept. 41, 206 p., illus., tables, 1967.

Bedrock underlying the Brazos River valley in the report area range in age from Late Cretaceous to Quaternary. Cretaceous exposed rocks, mostly limestone, marl, and shale, are mainly consolidated and do not contain important aquifers; Tertiary rocks, chiefly shale, clay, and sand, contain several of the major aquifers in Texas. Terrace and flood plain alluviums are as thick as 75–100 feet, respectively, but average much less. Ground water is discharged from the alluvium chiefly by seepage into the Brazos River, by evaporation and transpiration, and by wells. Chemical quality of water ranges widely; in general it is suitable for domestic and livestock purposes (except that it is hard) and also for irrigation. As of spring 1963 approximately 2,760,000 acre-feet of water was in storage in the flood-plain alluvium.—*from* Authors' abstract

00453 **Crooks, James W.; O'Bryan, Deric.** (and others). Water resources of the Patuxent River basin, Maryland: U.S. Geol. Survey Hydrol. Inv. Atlas HA-244, 5 sheets, scale 1:250,000, text, 1967.

Sheet 1 includes a generalized geohydrologic map and three profiles showing the Piedmont and Coastal Plain aquifers; sands and gravels of the latter are the most productive. Sheet 2 contains maps of streamflow and water budget; precipitation, streamflow duration, and ground-water movement differ perceptibly from one part of the basin to another, providing the basis for subdividing the basin into four hydrologic zones. Sheet 3 concerns chemical quality of surface water and erosion and sedimentation; increased development in the reach between Washington and Baltimore will make the problems more evident. Sheets 4 and 5 contain discussions and illustrations of pollution index of streams and water movement, respectively.—M.C.M.

10509 **Cross, Aureal T.; Thompson, Gary G.; Zaitzeff, James B.** Source and distribution of palynomorphs in bottom sediments, southern part of Gulf of California: Marine Geology, v. 4, no. 6, p. 467–524, illus., table, 1966.

Detailed analyses are given of bottom surface sediments from about 150 cores of the southern half of the Gulf of California, and preliminary analyses for another 100 sediment samples from throughout the Gulf. Background data from stream and surface sediments of the surrounding regions in Mexico aid interpretation of distribution of the pollen and spores found. Conditions and characteristics of environment, plant distribution, structure of the basin, geomorphology and sedimentation of adjacent regions are reviewed. Map-graphs show depth of sample, bottom profiles and sand-silt-clay ratios, for comparison with relative frequencies of various types. Dispersal by stream and offshore water currents appear to be more important than by wind.—G.D.C.

Crouse, D. J. *See* Hurst, F. J. 10418

00333 **Crowder, Dwight F.** Mineral resources of the Devil Canyon–Bear Canyon primitive area, California: U.S. Geol. Survey Bull. 1230-G, p. G1–G21, illus., tables, geol. map, 1967.

The Devil Canyon–Bear Canyon primitive area in Los Angeles County is underlain by a variety of granitoid rocks mostly of igneous origin, and cut by a few dikes. The San Gabriel fault zone cuts these rocks along the south border and appears to have displaced the rocks to the east; along a part of the zone rocks are friable and easily eroded. Other faults are common but their displacements are unknown. Analyses of rocks, of soils over rocks, of stream sediments, and of heavy minerals from stream sediments reveal no significant concentration of valuable mineral commodities. Lenses and veins contain only trace amounts of minerals, and none are of potential commercial value.—*from* Author's abstract

10416 **Crozaz, G.; Langway, C. C., Jr.; Picciotto, E.** Artificial radioactivity reference horizons in Greenland firn: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 208, 8 p., illus., 1966.

In estimating net budget of polar ice sheets, determination of snow accumulation rates is a vital factor. Total beta measurements on melt water samples from a stratigraphically dated firn core profile from the inland Greenland ice sheet (77°10′ N., 61°08′ W.) reveal a marked increase in radioactivity in the 1953 firn layer corresponding to the first important fallout from nuclear test bombs. The pre-1953 natural beta activity is 5 dpm/kg. The influx of artificial debris from Ivy tests in 1953 is indicated by a sharp rise in beta activity to 10 dpm/kg. Total Sr-90 deposit to June 1964 is 9.3±1.5 millicuries/km^2 (24±4 mC/mi^2). Average Pb-210 activity at time of deposit is 3.9±0.4 dpm/kg.—G.D.C.

10498 **Csallany, Sandor C.** Application of radioisotopes in water resources research, *in* Am. Water Resources Conf., 2d Ann., Chicago, 1966, Proc.: Am. Water Resources Assoc. Proc. Ser., no. 2, p. 365-373, table, 1966.

The primary goal of this paper is to review and summarize the application of radioisotopes in water resources research. The various methods and isotopes being used were compiled from available literature and research information sources, and are listed according to main categories and specific fields of research in water resources. A summary is given on the present status and possible future use of radioisotopes in these various areas of water resources research.—Author's abstract

00414 **Culbertson, James K.** Nomenclature for bed forms in alluvial channels—Discussion [of paper 4823, by ASCE Task Force, 1966]: Am. Soc. Civil Engineers Proc., v. 93, Jour. Hydraulics Div., no. HY 2, p. 74-77, illus., 1967.

Virtually all types of bed configurations described by authors (ibid., v. 92, no. HY 3, p. 51-64, 1966) have been observed in laboratory flumes. Photographing them under flow conditions in the field is almost impossible. An ultra-sonic sounder, used in the field by this writer, records transverse bars. Illustrated are 12 sonic-sounder records observed along the center line of the Rio Grande Conveyance Channel near Bernardo, N. Mex., and a sounder trace of periodic transverse bars downstream, which in five days coalesced to form two large bars. The writer would like to see in the author's closure the order of appearance of various bed configurations as discharge increases or decreases in a sand channel.—G.D.C.

00440 **Curray, Joseph R.; Nason, Robert D.** San Andreas fault north of Point Arena, California: Geol. Soc. America Bull., v. 78, no. 3, p. 413-418, illus., 1967.

Continuous reflection profiling north of Point Arena, Calif., shows that the San Andreas fault bends toward Shelter Cove rather than continuing in a straight line from the southeast. North of Shelter Cove, the fault probably remains near shore until it reaches the vicinity of Punta Gorda, and may then curve westward along the Gorda Escarpment.—Authors' abstract

00360 **Curtis, Larry W.** Harry F. Suffield, 1916-1966: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 2, p. 285, portrait, 1967.

Cutshall, Norman. *See* Johnson, Vernon. 00325

00535 **Cys, John M.** Two new minor morphological features of *Diadectes*: Jour. Paleontology, v. 41, no. 1, p. 256, 1967.

A specimen in the University of California Museum of Paleontology has a single longitudinal row of palatal teeth along the midline from its anterior end on the vomer to a point even with the sixth nonincisiform cheek tooth. At this point the row diverges into two rows which continue posteriorly. The lower jaw has one more nonincisiform tooth than the upper jaw.—F.C.W.

10354 **Davis, Dan A.; Yamanaga, George.** Preliminary report on the water resources of the Kau District, Hawaii: Hawaii Div. Water and Land Devel. Circ. C27, 25 p., illus., tables, 1966.

The Kau District includes the southeastern slope of Mauna Loa and the southwestern part of Kilauea, and is underlain by highly permeable lava flows, with several beds of less permeable ash and tuff. On Mauna Loa, the Ninole Series, Pliocene or older, is overlain by the Pleistocene Kahuku Series, and the later Pleistocene Pahala Ash overlies both. Historic and prehistoric flows of the Kau Series cover most of the volcano. The Pleistocene Hilina Series, forming the bulk of Kilauea, also is covered by Pahala Ash, overlain by the Puna Series. A geologic sketch map and tables show these relations. Rainfall is absorbed quickly and principal discharge is from basal-water springs along the shore, where the water is brackish. Largest fresh-water flow, 30 to 50 mgd, is between Punaluu and Honuapo. Perched water tables occur at high levels and have been tapped by tunnels.—E.S.L.

Davis, G. L. *See* Hart, S. R. 00614

00505 **Davis, George H.; Meyer, Gerald.** The availability of ground water: Water Well Jour., v. 21, no. 4, p. 63–64, illus., 1967.

Regions of the United States most likely for future ground-water development are Coastal Plain—most productive, principal aquifers sand or sand and gravel; western alluvial basins—prevailingly dry, thick alluvial deposits and perennial streams supplying water for large-scale irrigation agriculture; glaciated north-central region—best prospects in watercourse areas or outwash deposits, or permeable deposits in glacial drift; High Plains—alluvium still contains vast quantities of water, however, potential in the southern area is poor; Columbia Lava Plateau—light development but great reserves, depth to water prohibitive in some volcanics. Areas of limited ground water include the Appalachians, Rockies, Pacific Slope mountains, Colorado Plateau, Great Basin uplands, and unglaciated Central Interior Lowlands.—M.C.M'

Dawson, Mary R. *See* Black, Craig C. 10367

00541 **Dean, Walter E., Jr.; Anderson, Roger Y.** Correlation of turbidite strata in the Pennsylvanian Haymond Formation, Marathon region, Texas: Jour. Geology, v. 75, no. 1, p. 59–75, illus., 1967.

Thickness, composition, and paleocurrent direction in 768 siltstone-claystone couplets showed no significant variations with time, but the pattern of thickness variation could be used for correlation. Comparison of couplets in two outcrops 10.5 km apart produced a sliding correlation coefficient and correlation diagrams that revealed a 46-percent decrease in the number of couplets in a basinward direction. Siltstone thickness decreased 46 percent and claystone 26 percent in a direction away from the source.—V.E.S.

Deffeyes, K. S. *See* Russell, K. L. 00359

10454 **Delevoryas, Theodore.** Investigations of North American cycadeoids—Microsporangiate structures and phylogenetic implications: Palaeobotanist, v. 14, nos. 1–3, p. 89–93, illus., 1966.

The microsporangiate structure of the cone of *Cycadeoidea* [gymnosperms, Mesozoic, North America] seems to have been composed of a fleshy portion, continuous and cup-shaped below and with separate distal members, each with a fleshy appendage at the distal region. The structure was probably derived from a phyletic fusion of separate sporophylls, with tips still free although compactly appressed. Such an interpretation brings the cycadeoid cone closer to the cone structure of the bennettitalean genus *Williamsonia*. Also as in williamsonias, certain cycadeoids seem to have had monosporangiate fruiting structures, including a cone, described herein, with only microsporangia.—*from* Author's abstract

00612 **Denison, Rodger E.; Raveling, H. P.; Rouse, John T.** Age and descriptions of subsurface basement rocks, Pamlico and Albemarle Sound areas, North Carolina: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 2, p. 268–272, illus., table, 1967.

Igneous and metamorphic basement rocks underlie Mesozoic and Cenozoic sediments in the area. For six well cores, types of basement rock encountered,

depth, and geologic age correlative with isotopic age dates determined, are: granite gneiss, 5,248 feet, Early Cambrian with Ordovician metamorphism; biotite diabase, 8,377 feet, Late Devonian; gneissic granitic rock, 7,220 feet, latest Precambrian or earliest Cambrian; rhyolite porphyry, 3,400 feet, Early Devonian–Late Silurian; garnetiferous biotite schist and muscovitic quartzite, 4,540 feet, middle Permian metamorphism; and amphibolite, 6,281 feet, Middle Devonian. These rocks are similar in composition and age to those cropping out in the Piedmont and Blue Ridge Province. Subsurface basement rocks are overlain by Lower Cretaceous sediments which must pinch out or be truncated westward, as no surface exposures have been reported.—B.H.K.

10440 **Denson, Norman M.; Waagé, Karl M.** Some bauxite and clay deposits in northeastern Alabama: U.S. Geol. Survey Bull. 1199-P, p. P1–P27, illus., table, geol. maps, 1966.

Deposits of bauxite and pisolitic clay in northeastern Alabama were investigated in 1942–43 by the U.S. Geological Survey as part of a program of evaluation of the Nation's resources of aluminum ore. The bauxite and clay deposits described are scattered over an area about 70 miles long, in Cherokee, Calhoun, and Talladega Counties. The area is underlain by rocks of Early Cambrian to Ordovician age, obscured in many places by extensive surficial deposits of Tertiary and Quaternary age. None of the deposits contains bauxite of commercial importance as a source of aluminum under current economic conditions.—N.M.D.

10463 **Denton, George H.; Stuiver, Minze.** Neoglacial chronology, northeastern St. Elias Mountains, Canada: Am. Jour. Sci., v. 264, no. 8, p. 577–599, illus., tables, 1966.

Drift morphology, stratigraphy, and C–14 dates suggest chronology for Donjek and Kaskawulsh Glaciers. About 12,500 B.P. Kluane glaciers receded from near Kluane Lake and about 9780 B.P. withdrew behind present Kaskawulsh moraines. During Slims nonglacial interval, glaciers maintained retracted positions; Kaskawulsh terminus was located at least 13.7 miles up-glacier from its present position. Initial Neoglacial advance began before 2640 B.P.; continuous loess deposition suggests glaciers maintained positions more advanced than in Slims. The youngest advance occurring through the last few centuries is bracketed by seven C–14 dates; retreat began before A.D. 1865 and 1874. Comparison with events elsewhere supports initial widespread Neoglacial advance shortly before 2600–2800 B.P., and major events synchronous throughout the Northern Hemisphere.—*from* Authors' abstract

10625 **Devore, George W.** Elastic strain energy and mineral recrystallization—A commentary on rock deformation: Wyoming Univ. Contr. Geology, v. 5, no. 2, p. 19–43, illus., tables, 1966.

A model is developed to account for mineral recrystallization under directed stress resulting in a minimum Gibbs and a maximum Helmholtz free energy for equilibrium orientation. Correlations between calculated orientations, and observed preferred orientations are established for hornblende, mica, quartz, tourmaline, olivine and perhaps dolomite. Shear strain parallel to tectonic A is responsible for determining rock fabric but is a relatively unimportant strain in determining final mineral crystallization. It is suggested that uniform strain in a crystal is a requirement for equilibrium and grain size and orientation are influenced by uniform strain requirement; also indicated is the possibility that strain energy and thermodynamic equilibrium throughout a stressed system be used quantitatively to describe relative strain differences in different parts of the deformed system.—*from* Author's abstract

Dewald O. *See* Peter, G. 10503

00350 **Dibblee, T. W., Jr.** Geologic map of the Ludlow quadrangle, San Bernardino County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-477, scale 1:62,500, sections, separate text, 1967.

Map units described in the text are: Cenozoic sedimentary and volcanic rocks (surficial sediments, basalt flow, older alluvium, older valley sediments, basalt of Ash Hill, rhyolitic tuff, sedimentary rocks of Pacific Mesa, intrusive volcanic rocks, volcanic and sedimentary rocks, and dacite porphyry); Mesozoic hypabyssal igneous

rocks (diorite dikes); and Mesozoic plutonic igneous rocks (granitic rock, hornblende diorite, biotite quartz monzonite). Gold, silver, and copper mines and prospects are described briefly.—M.C.M.

00470 **Dibblee, T. W., Jr.** Geologic map of the Deadman Lake quadrangle, San Bernardino County, California: U.S. Geol. Survey Geol. Quad. Map GQ-488, scale 1:62,500, sections, separate text, 1967.

The map units described in the text are: Cenozoic sedimentary and volcanic rocks—surficial sediments, dissected alluvial fan gravel, basalt lava, older valley sediments, intrusive volcanic rocks, and volcanic and sedimentary rocks; Mesozoic plutonic and hypabyssal igneous rocks—quartz monzonite, dike rocks, hornblende diorite or gabbro, and older granitic rocks; and Paleozoic(?) metamorphic rocks—metasedimentary. Two gold-copper and one iron prospect are described.—M.C.M.

00547 **Dibblee, T. W., Jr.** Geologic map of the Emerson Lake quadrangle, San Bernardino County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-490, scale 1:62,500, sections, separate text, 1967.

Map units described in the text are: Cenozoic sedimentary and volcanic rocks (surficial sediments, older surficial sediments, basalt of Ruby Mountain area, basalt); Mesozoic hypabyssal and plutonic igneous rocks (quartz latite dikes, quartz pod, quartz monzonite, dike rocks, older granitic rocks, dioritic rocks); and Precambrian metamorphic rocks (gneissic rocks). Mines and prospects of copper-gold and radioactive minerals are described briefly.—M.C.M.

00621 **Dickinson, Kendell A.; Swain, Frederick M.** Late Cenozoic freshwater Ostracoda and Cladocera from northeastern Nevada: Jour. Paleontology, v. 41, no. 2, p. 335-350, illus., 1967.

Twenty-one species of Ostracoda and two of Cladocera were found in the middle and upper Humboldt Formation of probable Pliocene and early Pleistocene age, Elko and Lander Counties, Nev. Four zonal units, unnamed but possibly deserving assemblage-zone status, are recognized. In descending order they are: a unit in the upper Humboldt characterized by *Elkocytheresis bramlettei* and common to abundant specimens of *Limnocythere*, cladoceran ephippia, and rarer *Cypricercus*; a unit mostly in upper Humboldt characterized by *Candona chasei* and other abundant Ostracoda and cladoceran ephippia; a unit in upper middle Humboldt tuffaceous beds characterized by *Cypricercus parafuscatus*; and a unit in lower middle Humboldt tuffaceous beds characterized by *Limnocythere pterygoventrata and Elkocythereis* but few or no other ostracodes.—*from* Authors' abstract

10370 **Dietz, Robert S.** Passive continents, spreading sea floors, and collapsing continental rises: Am. Jour. Sci., v. 264, no. 3, p. 177-193, illus., 1966.

A tectonic model of the Earth in which both the continents and sea floor are resistant to internal deformation places the principal regions of orogeny on the continental rises, where prisms of sediment are incorporated into orogens that are accreted to the continents when decoupling allows the sea floor to underthrust the continental blocks. Arguments favoring this model include: (1) lack of deformation in Precambrian supracontinental strata, (2) persistence of ancient circular structures, (3) pattern of accretion of North America, (4) lack of orogenic crumpling of sediment layers on the sea floor.—D.L.D.

10522 **Dill, Robert F.** Erosion in the head of La Jolla submarine canyon [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 62-63, 1966.

Dinwiddie, G. A. *See* Reeder, H. O. 00455

10536 **Dodd, J. R.** Minor diagenesis in skeletal carbonates [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 7, 1966.

10558 **Dodd, Philip H.** Quantitative logging and interpretation systems to evaluate uranium deposits, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. P1–P21, illus., 1966.

The uranium mining industry relies increasingly on analysis of geophysical logs to obtain geologic and engineering information. A multipurpose logging system is presented including natural gamma-ray, density, and caliper probes, and surface analog and digital data systems. The natural gamma-ray and scattered gamma-ray density logs are discussed in detail, as applied to uranium exploration. Programs written in FORTRAN II for the IBM 7090 computer are used to interpret them quantitatively.—E.S.L.

10429 **Dolan, Robert.** Seasonal variations in beach profiles along the Outer Banks of North Carolina—Outer Banks, North Carolina, Beach Process Inv., Tech. Rept. 27, Pt. A: Louisiana State Univ. Coastal Studies Inst. Contr. 66-3, [5] p., illus., table, reprinted 1966; originally published 1965.

This is a reprint of the paper published in Shore and Beach, v. 33, no. 2, p. 22-26, 1965.—M.C.M.

10395 **Domzalski, W.** Importance of aeromagnetics in evaluation of structural control of mineralization: Geophys. Prosp. [Netherlands], v. 14, no. 3, p. 273–291, illus., 1966.

Structural conditions, which play an important part in emplacement of mineral deposits, are commonly reflected in the trends and intensities of aeromagnetic anomalies. A number of examples from the Canadian Shield, where aeromagnetic coverage is extensive, are discussed in illustration.—D.B.V.

00336 **Donn, William L.; Shaw, David M.** Exploring the atmosphere with nuclear explosions: Rev. Geophysics, v. 5, no. 1, p. 53–82, illus., tables, 1967.

Pressure waves from large nuclear explosions have been recorded at many stations over the Earth by instruments installed by the Lamont Geological Observatory. The propagation of these waves is controlled by gravity and the acoustic properties of the atmosphere in a manner that produces group velocity dispersion of the acoustic-gravity modes making up the signal. The nature of the wave dispersion depends on both the thermal and the wind stratification of the atmosphere. The casual relationships have been studied both experimentally and theoretically. To provide more data for air-wave investigations, the 208 Lamont records made at 15 stations from 45 nuclear explosions are presented here together with related data on source, times, and distances.—Authors' abstract

10645 **Dosso, H. W.** A plane-wave analogue model for studying electromagnetic variations: Canadian Jour. Physics, v. 44, no. 1, p. 67–80, illus., table, 1966.

A plane-wave analog model for studying the effect that various geologic structures have on the natural electromagnetic variations observed at the Earth's surface is described, and its validity discussed. Measurements of amplitudes and phase angles are obtained for a model flat Earth and for cylindrical bodies embedded in the surface layer.—E.S.L.

10641 **Dott, Robert H.** Geological framework of southern Oklahoma, *in* Pennsylvanian of the Ardmore Basin, southern Oklahoma—Ardmore Geol. Soc., Field Conf. 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., p. 19, 1966.

Two distinct elements compose the geologic framework of southern Oklahoma: the eastern Arbuckles, uplifted in Early Pennsylvanian time as part of the Wichita orogeny, and the Arbuckle anticline, of Late Pennsylvanian age, part of the Arbuckle orogeny but limited in space. The line of demarcation is the Washita Valley fault. Basement rocks in the Wichita Mts. and Arbuckle anticline are probably Middle and Lower Cambrian, not Precambrian as in the eastern Arbuckles. The Washita Valley fault is again the dividing line. Structural history is reviewed.—E.S.L.

Dreimanis, A. *See* Westgate, J. A. 00377

Duffell, S. *See* Wright, G. M. 10664

10449 **Dunbar, Carl O.** The Earth: Cleveland, Ohio, and New York, World Publishing Co., 251 p., illus., tables, 1966.

This book presents a synthesis of the highly diversified fields of science that describe the Earth as an abode for life. The purpose has been to present a broad view of the Earth for the intelligent reading public. References cited are mainly to general works rather than to technical journals not readily available. Chapter headings are: the road to understanding, the scale of time, the universe around us, the planet Earth (the lithosphere, the hydrosphere, the atmosphere), origin of the solar system, formative stages of the Earth, Earth's ever-changing face, climates of the past, the driving force within, and life's record in the rocks.—E.S.L.

Duncan, Walter W. *See* Gronewald, Gail J. 10578

00404 **Dunham, A. C.; Hanor, J. S.** Controls on barite mineralization in the western United States: Econ. Geology, v. 62, no. 1, p. 82–94, illus., tables, 1967.

Barite deposits are largely confined to the Nevadan batholith belt, the late Paleozoic Antler orogenic belt, and to areas of uplift in the Laramide orogenic belts. It occurs in areas characterized by diorite–granodiorite and latite–monzonite associations, with Niggli K-values between 0.2 and 0.4 (at 60 percent SiO_2), and is generally absent from basaltic, alkalic, and spilite–keratophyre provinces. These relationships suggest a magmatic origin, with the following controls: low potassium (high Ca and Na), which allows melt to become enriched in Ba in absence of potash mineral phases in which it would become fixed; high water content of magma, to permit escape; favorable structure.—W.S .W.

00511 **Dunn, David E.** Large diameter demonstration stereonet: Jour. Geol. Education, v. 15, no. 1, p. 17, illus., 1967.

Construction of a large diameter net for classroom demonstrations in structural geology is described; plywood is used as a screen and a published net is projected on to it and traced. A circular plexiglass sheet can be used over it for solving problems.—E.S.L.

Dutton, C. E. *See* Bayley, R. W. 10407

00351 **Dutton, Carl E.; Linebaugh, Reta E.** Map showing Precambrian geology of the Menominee iron-bearing district and vicinity, Michigan and Wisconsin: U.S. Geol. Survey Misc. Geol. Inv. Map I-466, scale 1:125,000, 1967.

The map sheet includes a generalized geologic map of northern Michigan and Wisconsin showing location of the Menominee iron-bearing district, a map showing areal extent of Cambrian and Ordovician rocks in the area, and a list of references.—M.C.M.

Eagleson, P. S. *See* Johnson, J. W. 10451

00407 **Eales, Hugh V.** Reflectivity measurements on molybdenite [discussion of paper by J. H. Leow, 1966]: Econ. Geology, v. 62, no. 1, p. 151–153, illus., 1967.

Polishing produces a surface layer whose properties, such as reflectivity, may differ from theoretical properties of the same material. Differences of several percent in reflectivity can be created in silver by different polishing methods. Cleavage surfaces of sphalerite have reflectivity different from that of polished surfaces. (See Leow, ibid., v. 61, p. 598–612.)—W.S.W.

00550 **Ebanks, Gerald Keith.** Structural geology of Keechi salt dome, Anderson County, Texas [abs.]: Houston Geol. Soc. Bull., v. 9, no. 5, p. 17, 1967.

10350 **Eden, W. J.** An evaluation of the field vane test in sensitive clay, *in* Vane shear and cone penetration resistance testing of in-situ soils—ASTM Pacific area Natl. Mtg., 5th, Seattle, Wash., 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 399, p. 8–17, illus., table, 1966.

For the past 10 years, the Division of Building Research has employed the field vane apparatus to measure the undrained shear strength of the sensitive Leda clays of eastern Canada, which have an overconsolidation of from 0.3 to 5.0 tons/ft^2. The apparatus has also been used in the nearly normally consolidated varved clays of northern Ontario and Quebec. This paper summarizes this experience and attempts to assess the usefulness of the field vane in relation to other field evidence. For the soft, lightly overconsolidated clays (undrained shear strength less than 0.5 tons/ft^2), the field vane yields consistent undrained strengths which have correlated well with other field evidence. For stronger clays (overconsolidated from 3 to 5 tons/ft^2), the value of field vane tests is questionable.—Author's abstract

10352 **Egan, Gail N.; Agogino, George A.** Fluorine analysis procedures used in determination of the age of fossils: Texas Jour. Sci., v. 18, no. 4, p. 406–416, 1966.

Various methods for determining age of fossils are reviewed. Lack in popularity of the fluorine analysis method is due to its high cost and tedious analytical procedures. Possibilities of using volumetric titrations, spectrography, X-ray diffraction, and tracer technique for analyzing fluorine in fossils are explored. Results of various analyses were considerably lower than the normal theoretical value.—M.A.K.

00312 **Eicher, Don L.** Foraminifera from Belle Fourche Shale and equivalents, Wyoming and Montana: Jour. Paleontology, v. 41, no. 1, p. 167–188, illus., 1967.

Thirty-four species of Foraminifera were found in the Cretaceous Belle Fourche Shale and its lithogenetic equivalents at seven localities in Wyoming and Montana. Only one, *Ammomarginulina paterella*, is new. Arenaceous specimens dominate except in beds transitional with the overlying Greenhorn Formation. Rare planktonic specimens from scattered samples, including some from the lowermost Belle Fourche, suggest that the restricted interior seaway was connected physically with normal open marine environments, probably to the south. Though local sequences of arenaceous assemblages differ, the general increase in abundance and diversity upward suggests increasingly open marine environments during Belle Fourche deposition.—*from* Author's abstract

00339 **Ekren, E. B.; Frischknecht, F. C.** Geological-geophysical investigations of bedrock in the Island Falls quadrangle, Aroostook and Penobscot Counties, Maine: U.S. Geol. Survey Prof. Paper 527, 36 p., illus., tables, geol. map, 1967.

Bedrock in the Island Falls quadrangle was studied by means of electromagnetic and magnetic surveys in conjunction with conventional geologic mapping techniques. The rocks range in age from Cambrian(?) to Devonian and consist dominantly of cyclically bedded graywacke and slate. Ordovician spilite and keratophyre lavas as much as 12,000 feet thick form a rugged ridge in the central part of the quadrangle, and two large stocks of quartz diorite crop out in the north-central part. The stocks predate Lower Silurian conglomerates and are considered to be Ordovician in age. Electromagnetic surveys traced many zones of black slate in strata of Cambrian(?), Ordovician, and Silurian age. Ground magnetic surveys indicated that much of the black slate is magnetic as well as conductive.—E.B.E.

Elvers, D. *See* Peter, G. 10503

10542 **ElWardani, S. A.** Geochemical significance of the deep-sea nepheloid layers [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 34, 1966.

10346 **Emery, K. O.** Atlantic continental shelf and slope of the United States—Geologic background: U.S. Geol. Survey Prof. Paper 529-A, p. A1–A23, illus., 1966.

A joint investigation of the geology of the continental margin off the Atlantic coast of the United States was begun during 1962 by the U.S. Geological Survey and the Woods Hole Oceanographic Institution. It includes studies of topography, sedimentology, lithology, structure, water, and biology. Background information and general results of the program are given in this chapter to establish a framework for subsequent chapters on detailed results. Topographic maps for the entire region have been completed as bases for plotting field and laboratory results and for making physiographic interpretations. About 2,000 well-distributed samples of surface sediment are being analyzed. Dredgings have yielded new samples of bedrock, and several thousand kilometers of continuous seismic profiles provide information about the stratigraphy and structure of the region.—K.O.E.

Emilia, David A. *See* Berg, Joseph W., Jr. 10360

00373 **Engel, Noel W.** Harold Merritt Horton (1897–1966): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 435, portrait, 1967.

10573 **Erickson, Bruce R.** Mounted skeleton of *Triceratops prorsus* in the Science Museum: Sci. Mus. Sci. Pub., new ser., v. 1, no. 1, 16 p., illus., table, 1966.

Among reptilian remains recovered during five field seasons in Hell Creek beds of northeastern Montana were two incomplete skeletons of the ornithischian dinosaur *Triceratops prorsus*, which form the basis of a recently mounted skeleton in St. Paul, Minn. Previously mounted skeletons incorporate bones belonging to numerous individuals as well as to more than one species. The present mount uses materials of a single species, considered to represent an immature animal in spite of an enormity of size that is inconsistent with other interpretations regarding the species. The materials, collected from the Hell Creek Formation in Garfield County, and the mounted skeleton and method of mounting are described.—G.D.C.

Ern, E. H. *See* Crenshaw, A. B. 10666

Essington, E. H. *See* Nishita, H. 00388

Etter, W. C. *See* Liu, T. K. 10399

Eugster, Hans P. *See* Kujawa, Frank B. 10473

10494 **Fairbridge, R. W.** Geological and cosmic cycles, *in* Interdisciplinary perspectives of time—Conf., 1966: New York Acad. Sci. Annals, v. 138, art. 2, p. 433–439, illus., 1966.

Faulting, diapiric rises, and other geotectonics may be repeatedly triggered by diurnal stress of oceanic and body tides. When the planets are alined on one side of the Sun, its normal heliocentric position is displayed by gravitational attraction, which may lead to solar flares, and geotectonic disturbances. Impact of radiation on the upper atmosphere strengthens the Earth's thermal blanket. Rise of temperature of 1°C has been observed over the last 50 years, while the mean height of sun spot peaks doubled, glaciers retreated, and melt waters raised sea level. Correlation of a 200-million-year geotectonic revolution with the Galactic rotation cycle and of 30-million-year geologic phases with intragalactic cycles are tempting. In organic evolution, environmental controls that are inorganic in origin have marked oscillations, but biological continuity survives.—G.D.C.

10492 **Fairbridge, Rhodes W.** Endospheres and interzonal coupling, *in* Planetology and space mission planning—Sec. 1, Environments: New York Acad. Sci. Annals, v. 140, art. 1, p. 133–148, illus., table, 1966.

An example of interzonal couplings is variation in ultraviolet radiation producing a cold epoch, and assymetric ice loading leading to an abrupt shift of the axis. Atmosphere–hydrosphere coupling results in mass transfers of material causing crustal depression and uplift, or larger basins and uplifts may result from polar shifts. Study of the Earth's core indicates that each outer layer represents phase changes of the original ultra phase. Magnetic reversal every few million years involves a decay time, possible extinction of the Van Allen belt, and higher cosmic

radiation on Earth. These reversals correspond to remarkable interruptions in the paleontologic record. All planets must have had periods of rapid expansion, such as that of Earth in late Triassic–early Jurassic time; continents were separated by growth of oceanic crust. Paleoclimatology shows interzonal couplings differentiated by orders of magnitude in time.—E.S.L.

Fatt, I. *See* Munjal, P. 10390

00356 **Faust, George T.; Nagy, Bartholomew S.** Solution studies of chrysotile, lizardite and antigorite: U.S. Geol. Survey Prof. Paper 384-B, p. 93–105, illus., tables, 1967.

The differential solution method for discriminating among chrysotile–lizardite–antigorite was restudied and the results evaluated. This method discriminates chrysotile from lizardite and antigorite, and yields semiquantitative values for chrysotile. The identification of the platy phase in the pair lizardite–antigorite requires X-ray diffractometer methods. The use of dilute hydrochloric acid to remove iron oxides and carbonates from mineral separates causes the attack of the chrysotile.—G.T.F.

Feigl, F. J. *See* Fetzner, R. W. 10570

Feldmann, Rodney M. *See* Holland, F. D., Jr. 00534

10570 **Fetzner, R. W.; Henson, W. L.; Feigl, F. J.** Athabasca oil sand evaluation using core and log analysis and geological data processing methods, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. A1–A12, illus., 1966.

The [Athabasca] sands contain up to 18 percent by weight of low gravity oil or tar and are lenticular and interbedded with shale and silt strata. To determine in place oil content and other ore body characteristics, an extensive coring and well-logging program was conducted, and a well-log analysis computer program, and core analysis and geologic data processing systems used. The formation density–laterolog 3 combination proved best for porosity and water-saturation measurements. Numerous comparisons of core vs. log-analysis results indicate that conventional log-analysis methods will ascertain accurate oil content. Core and log information were combined to produce continuous oil and water saturation and bulk density profiles for each test hole; stratigraphic correlations and oil grade cutoff tops and bases were also included. Maps and cross sections defining the oil-sand ore body were produced.—*from* Authors' abstract

Fisher, D. E. *See* Rancitelli, L. 00477

Fisher, D. W. *See* Rhodes, F. H. T. 10471

00463 **Fisher, David E.** On the origin of fissiogenic xenon in meteorites: Jour. Geophys. Research, v. 72, no. 2, p. 765–769, illus., 1967.

An attempt is made to show that the measured mass curve for xenon abundance in meteorites is actually consistent with both U-235 thermal-neutron fission and U-238 spontaneous fission. Of the possible sources, thermal-neutron fission of U-235 is considered most likely. Until an upper limit to the neutron-fission contribution can be set, neither the Xe isotopes nor the fossil fission tracks should be made the basis for Pu-244-fission age calculations. From another point of view, the measurements set an upper limit to the thermal neutron flux involved in a primordial uniform irradiation.—D.B.V.

10368 **Fisher, Richard V.** Mechanism of deposition from pyroclastic flows: Am. Jour. Sci., v. 264, no. 5, p. 350–363, illus., tables, 1966.

Drag resistance developed between a pyroclastic flow and the ground results in a transitional zone of low velocity between the maximum velocity of the flow and the stationary ground. Fragments of all sizes within the turbulent flow travel irregular paths and therefore enter the reduced velocity zone at random and are deposited together irrespective of size. This process results in poorly sorted deposits

with systematic vertical variations in mineralogy which are dependent upon variations in the original magma chamber and with lateral variation which are dependent upon the gradual energy losses of the main flow. Mineral variations in one unit of a compound cooling unit, the Picture Gorge ignimbrite, from the John Day Formation in eastern Oregon are explained on the basis of the above model.—*from* Author's abstract

Flamm, E. J. *See* Nir, A. 10413

00508 **Flawn, Peter T.** The other road: Jour. Geol. Education, v. 15, no. 1, p. 5-7, 1967.

The other road leading to effective application of geology is environmental geology, as contrasted with the new geology oriented toward the physical sciences. It includes engineering geology, economic geology (resources), and aspects of geomorphology, and provides an opportunity for the small department or the liberal arts college to relate geology to the broader curriculum. The need for the geologist in urban development and land use planning is described. Progress in creating geological opportunities will be more rapid if university faculties give attention to needs of the agencies.—E.S.L.

10474 **Flint, Richard Foster.** Comparison of interglacial marine stratigraphy in Virginia, Alaska, and Mediterranean areas: Am. Jour. Sci., v. 264, no. 9, p. 673-684, illus., table, 1966.

Stratigraphic and morphologic features in a sector of the coastal plain in southern Virginia define several former positions of relative sea level, of pre-Wisconsin Pleistocene age. Comparison of the stratigraphic features with well-documented features of somewhat similar character in the vicinity of Nome, Alaska, and on the island of Mallorca shows similarities among the three sequences. The similarities are independent of altitude, a parameter considered unreliable in the existing state of knowledge. They suggest that with accumulation of further data, long-distance correlation of at least some Pleistocene strandline features, by conventional stratigraphic methods, can be expected.—Author's abstract

10502 **Foley, Frank C.; Latta, Bruce F.** Salt water encroachment from industrial operations, *in* Am. Water Resources Conf. 2d Ann., Chicago, 1966, Proc.: Am. Water Resources Assoc. Proc. Ser., no. 2, p. 56-63, 1966.

The petroleum industry is undoubtedly the major source of salt contamination; salt mining, producers of various chemicals from brines, users of salt beds for storage sites, and the use of salt on highways to melt snow and ice also contribute. In areas such as the Permian basin it may be difficult to distinguish brine from natural springs and discharge seeps from old oil wells; the concentration and volume vary from formation to formation and field to field. Many of today's problems stem from poor disposal practices of the past. In the salt producing industry, the only hazard from shaft mining is the dumping of waste salt on the ground; in hydraulic mining it is the escape of circulating fluids and waste effluent from evaporating plants. Improved techniques and controls are now preventing much contamination.—G.D.C.

Foreman, Dennis W., Jr. *See* McConnell, Duncan. 10667

Foster, Helen L. *See* Whitmore, Frank C., Jr. 00311

00491 **Foster, Robert J.** Geology of the Rampart Ridge–Keechelus Ridge area, central Cascade Mountains, Washington: Northwest Sci., v. 41, no. 1, p. 32-41, illus., 1967.

Dating by three new fossil leaf localities, lithic similarity with Naches Formation, structural relationships, and correlation of ash flow at Lake Keechelus with Stevens Ridge Formation at Mt. Rainier all indicate that Rampart Ridge is underlain by Naches Formation, rather than Keechelus Andesite. Although not specified in 1906, Lake Keechelus has been considered the type area, but Foster (1960) designated Rampart Ridge for Keechelus Andesite. As one of the first areas mapped in the

Cascade Mts., formational names used here have been widely extended. Rocks originally mapped Keechelus in Snoqualmie quadrangle are older in the northern than southern parts which are now related to units in the Mt. Rainier area. Previously unrecognized intrusive bodies described herein, especially concordant glomeroporphyritic basalt, have contributed to the stratigraphic problem.—G.D.C.

10476 **Fournier, R. O.; Rowe, J. J.** Estimation of underground temperatures from the silica content of water from hot springs and wet-steam wells: Am. Jour. Sci., v. 264, no. 9, p. 685–697, illus., tables, 1966.

Solubility of quartz at depth is the major control on the amount of silica in solution in hot spring pools. Hot waters ascending rapidly to the surface become supersaturated with respect to quartz because of rapid cooling, separation of steam, and sluggish deposition of quartz and other crystalline SiO_2 phases. The silica content of boiling water discharged at the surface can be used to estimate underground temperature of last equilibrium with quartz, provided correction is made for steam forming during solution ascent. Using such correction, curves are presented showing dissolved silica measured in water discharged at the surface versus underground temperatures of last equilibrium with quartz. The method was applied to three wet-steam wells, and good agreement was obtained between the estimated and measured maximum temperature at depth.—*from* Authors' abstract

Fowler, G. A. *See* Russell, K. L. 00359

10661 **Fox, P. J.; Girdler, R. W.** (editors). Bibliography of research papers on the world rift system—Sec. 1, The Mid-Oceanic Ridge System; Sec. 2, Continental rift system—Pt. A, United States: Palisades, N. Y., Lamont Geol. Observatory, World Data Center A, Upper Mantle Project, 59 p., 1966.

The first section of this preliminary version of the bibliography is annotated, and citations are listed chronologically under seven subject headings. The references contain data and interpretations from one or more oceanographic expeditions. The second section is not annotated and citations, listed in chronological order, cover mostly the California area.—E.S.L.

Frank, E. R. *See* Cadle, R. D. 00433

Frautschy, Jeffery D. *See* Inman, Douglas L. 10574

00551 **Freeman, Paul S.** Clastic diapirism in the Gueydan (Catahoula) Formation, Live Oak and McMullen Counties, Texas [abs.]: Houston Geol. Soc. Bull., v. 9, no. 5, p. 17, 1967.

00496 **Frink, John W.; Fulcher, Martin K.** Effective use of Upper Snake River water resources: Am. Soc. Civil Engineers Proc., v. 93, paper 5147, Jour. Irrigation and Drainage Div., no. IR 1, p. 99–112, illus., 1967.

About one-third of the drainage area above King Hill carries discharge from a potential source of ground water. This part of the Snake River basin is underlain by basaltic lavas interbedded at places with fluvial sediments, bounded by subparallel mountains and valleys of various rocks. Typical basalt flows, 10 to 50 feet thick, dense and fine-grained at the base, coarse-grained in the middle, are fractured at the top, and, except where voids are filled with sediments, the most permeable rock on earth; aquifer thickness is unknown. South of the river the flows are fewer and interfinger with many sediments. The potential ground-water supply far exceeds the present need; water table depths of 50 to 1,000 feet are found. Development can affect this level, and diminish discharge flow now controlled by water rights.—G.D.C.

Frischknecht, F. C. *See* Ekren, E. B. 00339

Fritze, K. *See* McMullen, C. C. 10649

00412 **Frondel, Judith W.** X-ray diffraction study of some fossil and modern resins: Science, v. 155, no. 3768, p. 1411–1413, illus., table, 1967.

It is found that most fossil resins yield only diffuse X-ray diffraction patterns, though some have relatively sharp patterns. Many modern resins give sharp and distinctive patterns. Some crystalline constituents of the resins which yield the X-ray diffraction patterns have been identified. The similarity between the modern *Protium* and *Bursera* patterns and those of the fossil Highgate copalite and guayaquillite suggests the possibility of a genetic connection between these modern and fossil resins.—D.B.V.

00483 **Fryxell, Roald.** Ice-flow pattern reconstructed for the Okanogan lobe of the Cordilleran Ice Sheet, north-central Washington [abs.]: Northwest Sci., v. 41, no. 1, p. 50, 1967.

00555 **Fujii, Takashi.** Long-range order of aluminum and silicon in muscovite: Jour. Geology, v. 75, no. 1, p. 1–10, illus., table, 1967.

The long-range order-disorder of Al–Si within the tetrahedral layer of muscovite is discussed by the nearest neighbor model. According to this model, the lambda point exists, but it is lower than that of margarite. If the percentage occupancies of aluminum at the T_1 and T_2 sites of the cations of the tetrahedral layer can be estimated by some methods, the consistency of the estimates should be examined by computing the degree of order.—Author's abstract

Fulcher, Martin K. *See* Frink, John W. 00496

10582 **Fullerton, Donald S.; Wilson, Charles W., Jr.** Mineral resources summary of the Nashville West quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 13 p., table, 1966.

This text accompanies Tennessee Div. Geology Geol. Map GM 308-NE by C. W. Wilson, Jr., 1966 (cited separately). Mineral resources mined in the Nashville West quadrangle are limestone, gravel, sand, and clay. Only one of the 36 limestone quarries is active; the best sources of stone for most uses are in the Bigby–Cannon, Catheys, Leipers, Carters, and Laurel Formations. Silica and clay used in cement manufacturing and clay for tile are dug from the Cumberland River flood plain. Sand and gravel occur in alluvial deposits in the Cumberland River bed and flood plain and its larger tributaries.—M.C.M.

Funasaki, Gerald T. *See* Palmer, Robert Q. 10595

Funkhouser, J. *See* Rancitelli, L. 00477

10523 **Gaal, Robert A. P.** Marine geology of the Santa Catalina basin, California [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 64, 1966.

00526 **Galle, O. Karmie; Angino, Ernest E.** Determination of calcium and magnesium in carbonate and silicate rocks by atomic absorption, *in* Short papers on research in 1966: Kansas Geol. Survey Bull. 187, pt. 1, p. 9–11, illus., table, 1967.

Two wet chemical methods for the determination of calcium and magnesium were adapted to atomic absorption analysis. Experimental work was carried out with four National Bureau of Standard samples and reagent-grade calcium carbonate. Results were compared and found to be in reasonable agreement. The effect of four common acids on the analytical sensitivity of Ca and Mg by atomic absorption was also tested. Perchloric acid provides the greatest sensitivity and H_2SO_4, the least. Nitrate was found to interfere with the determination of Ca and Mg, but it can be eliminated by the addition of Sr or NH_4Cl.—*from* Authors' abstract

10568 **Gans, Philip.** Quantitative well log analysis via computer driven graphic terminals, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. EE1–EE15, illus., 1966.

New computer connected cathode ray tube consoles allow both the graphic display of exploration data and the on-line communication with the displayed data. Logs or selected portions of logs and scaling can be selected and displayed at will. A

light sensing pen associated with the console allows operator selection of specific points on the image, i.e., light pen selection of bed and zone boundaries. With the light pen and/or an associated alphanumeric keyboard, input parameters can be entered. The capability described above allows the log analysts to monitor the solution continually, change input parameters and the solution path at will, and in a real sense perform on-line interpretation of the logs.—Author's abstract

10593 **Garland, G. D.** (editor). Annual report: Canadian Geophys. Bull., v. 19, 185 p., illus., 1966.

Results of geophysical investigations in Canada are reviewed for the year in the fields of geodesy and gravity, seismology and physics of the Earth's interior, meteorology and atmospheric sciences, hydrology, geomagnetism and aeronomy, oceanography, glaciers, isotopic studies and geochronology, exploration geophysics, and volcanology. Each chapter contains a bibliography for the year.—E.S.L.

Garrels, Robert M. *See* Mackenzie, Fred T. 00392

Garrels, Robert M. *See* MacKenzie, Fred T. 10461

10482 **Garrison, Louis E.; McMaster, Robert L.** Sediments and geomorphology of the continental shelf off southern New England: Marine Geology, v. 4, no. 4, p. 273–289, illus., tables, 1966.

Investigations of the continental shelf between Hudson Canyon and Georges Bank reveal wave-cut terraces at 13, 45, 65, and 80 fathoms and concentrations of beach ridges around 35 fathoms each indicative of former low sea levels. The pre-Holocene drainage pattern, exposed over part of the area shows that Block Channel was the main stream of a system draining most of southern New England. A large delta at its mouth near the edge of the shelf shows the volume of sediments transported by the stream. Surface sediments on the western shelf are late Pleistocene fluvial deposits, reworked by the Holocene transgression. Overlying these coarse deposits in the central part of the outer shelf is a relict sandy silt facies. The youngest facies, and the only area of present deposition, is in the northeast where sand eroded from Nantucket Shoals is being deposited.—*from* Authors' summary

00607 **Gaskill, David L.; Godwin, Larry H.; Mutschler, Felix E.** Geologic map of the Oh-be-joyful quadrangle, Gunnison County, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-578, scale 1:24,000, sections, text, 1967.

About six beds in a zone about 250 feet thick overlying the second sandstone unit in the Mesaverde Formation contain coal of high volatile B bituminous and anthracite rank. About 3 million tons of coal was produced from 1885–1954, but mines have not operated since 1954. Original reserves in beds over 14 in. thick with less than 1,000 feet of overburden were about 18 million tons. Zinc, lead, silver, copper, molybdenum, and iron-sulfide deposits containing gold are associated with the north-northeast-trending system of faults, dikes, and small stocks of the Ruby Range and the breccia plug in Redwell Basin; only two mines were operating in 1964. Prospects for oil or gas are marginal. The area contains extensive gravel deposits.—M.C.M.

10610 **Geach, Robert D.** Thorium deposits of the Lemhi Pass district, Beaverhead County, Montana: Montana Bur. Mines and Geology Spec. Pub. 41, 22 p., illus., table, 1966.

The Lemhi thorium deposits are on the continental divide between Montana and Idaho. Basement rock in the district is part of the Precambrian Belt Series; igneous rocks include Tertiary volcanic rocks, small intrusive masses of diorite, and narrow lamprophyric dikes. The structure is complicated by folding, faulting, and warping, but strikes and dips in the northwestern part suggest that the principal structure may be a broad anticline trending northwest. The thorium deposits are quartz veins, with rare earth elements present. Brief descriptions of some veins are given.—*from* Author's abstract

Gentile, Richard J. *See* Keller, W. D. 00608

10526 **Gershanovich, D. E.** New data on the geomorphology and Recent sediments in the extreme northern part of the Pacific Ocean [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 67–68, 1966.

10404 **Gheith, Mohamed A.** Geochemical differentiation in terrestrial environments, *in* Planetology and space mission planning—Sec. 2, Signatures: New York Acad. Sci. Annals, v. 140, art. 1, p. 275–280, illus., 1966.

The most remarkable terrestrial differentiation is the first order vertical differentiation into iron-rich core, mantle, and crust. The lower mantle is assumed to consist of high-pressure phases, oxygen compounds of Mg, Si, and Fe; radioactive and lithophile elements having migrated into the upper mantle, the composition of which is controversial. There is horizontal differentiation due to second-order morphologic entities, continental and oceanic basins. The relation of the nonuniform distribution of radioactive elements to the time needed to melt rocks, and other causes of local melting are discussed. Geosynclines illustrate differentiation into third order units. Several geochemical belts may be found in the fourth order entities—geosynclinal areas, and metallogenic provinces; geologists differ as to the origin of these. Pegmatites, veins, and magmatic segregations constitute the fifth order.—E.S.L.

10465 **Gilbert, M. Charles.** Synthesis and stability relations of the hornblende ferropargasite: Am. Jour. Sci., v. 264, no. 9, p. 698–742, illus., tables, 1966.

Ferropargasite has been synthesized and its stability relations investigated. From most to least oxidized, assemblages produced on decomposition are magnetite, plagioclase, andraditic garnet plus fluid; magnetite, plagioclase, garnet, hedenbergitic pyroxene, nepheline plus fluid; and hercynite, plagioclase, fayalite, hedenbergitic pyroxene, nepheline plus fluid. Principal effects caused by substituting Fe for Mg are lowering the high tempefature stability limit at 1 kb fluid pressure from 1040°C to 835°C, and strong dependence of the ferropargasite stability field boundary on oxygen fugacity. Addition of silica lowers the upper thermal stability limit at low relative oxygen fugacities by 250°C or more for fluid pressures of 2 kb. At high relative oxygen fugacities, addition of silica results in an amphibole whose upper stability limit is raised nearly 75°C.—*from* Author's abstract

Gilby, J. M. *See* Swain, Frederick M. 00391

10357 **Gile, Leland H.** Coppice dunes and the Rotura soil: Soil Sci. Soc. America Proc., v. 30, no. 5, p. 657–660, illus., 1966.

Certain coppice dunes near Las Cruces, N. Mex., appear to have formed since 1885. The Rotura soil, formed in mid-Pleistocene sediments, is exposed between dunes but buried beneath them. The dunes overlie and preserve the pre-dune surficial horizons, and their stratigraphic relationships can be useful in genetic studies of thin upper horizons between dunes. Coppice dune materials are not presently recognized as individual soils but are designated by such terms as "hummocky phase"; with no apparent A or B zone development, roots and fauna have locally mixed the sediments. The coppice dunes dominate the microrelief and occupy major portions of the land surface in many areas, most of them thickly covered with vegetation. An alternative interpretation is that their sediments constitute a soil and should be classified.—G.D.C.

10489 **Gile, Leland H.** Cambic and certain noncambic horizons in desert soils of southern New Mexico: Soil Sci. Soc. America Proc., v. 30, no. 6, p. 773–781, illus., tables, 1966.

Horizons in B position may be ordered in degrees of increasing development forming continuous series closely related to age. Freshly deposited arroyo alluvium contains no evidence of soil development. Very weak soil development becomes apparent with increasing age, then cambic horizons and finally argillic horizons occur in B position. Distinct cambic horizons have formed in soils less than 5,000 years old,

with parent materials altered sufficiently to destroy fine strata, form structure, develop redder color, redistribute carbonate, or accumulate slight amounts of silicate clay. Older soils show evidence of greater changes in the B position. Argillic horizons apparently formed in some soils and were later destroyed, and some once had much thicker B horizons than now. Evidence indicates Pleistocene pluvials were wetter and cooler than at present.—*from* Editor's brief

10381 **Gilluly, James.** Orogeny and geochronology: Am. Jour. Sci., v. 264, no. 2, p. 97–111, tables, 1966.

Reporting a radiometric date of a hypogene mineral or plutonic rock as a date of orogeny is unjustified. Many orogenies proceed without associated plutonism and many plutonic events take place without orogeny. Stratigraphic terms should not be used for tectonic or plutonic events unless the events are concurrent with the deposition of the strata. The term "Grenville" has become meaningless because it has been used as a stratigraphic, provincial, tectonic and orogenic term spanning a great length of time and obscuring the tectonic and plutonic events of the Precambrian. "Grenville" should be used as a stratigraphic term only and new names coined for restricted plutonic and tectonic events which involve rocks of the Grenville series.—R.W.T.

Ginsburg, Robert N. *See* Traverse, Alfred. 10511

Girdler, R. W. *See* Fox, P. J. 10661

Glenn, E. E. *See* Baldwin, W. F. 10548

Glenn, J. L. *See* Prych, Edmund A. 10579

10658 **Godfrey, John D.** Geology of the Bayonet, Ashton, Potts and Charles Lakes districts, Alberta: Research Council Alberta Prelim. Rept. 65–6, 45 p., illus., tables, geol. maps, 1966.

The geology of 308.5 sq mi of Precambrian Shield in northeastern Alberta is presented on six colored maps, scale: 2 in. to 1 mi. Some 22 rock types have been distinguished; their characteristics are described and modal analyses given. The older granite gneiss complex of biotite and hornblende granite gneisses with minor amphibolite and metasedimentary rocks are predominant. Biotite granite F is petrologically distinct and unique in its close association with certain metasedimentary bands. All rock types have been subjected to intensive cataclasis giving rise to four major mylonite zones. Later intrusions of massive and foliated granites are concentrated in a band to the west. Confined faulting has developed secondary mylonites and breccias, aligned within the major zones, and transverse offsets. A northerly regional structural trend prevails.—G.D.C.

Godwin, Larry H. *See* Gaskill, David L. 00607

00613 **Godwin, Robert Paul.** The Mössbauer effect in surface studies, Fe^{57} on Ag [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 7, p. 2486B, 1967.

00528 **Goebel, Edwin D.** Age of Mississippian rocks in a core from northwestern Kansas, *in* Short papers on research in 1966: Kansas Geol. Survey Bull. 187, pt. 1, p. 15–16, table, 1967.

Conodonts recovered from a core from extreme northwestern Kansas indicate an age of late Osagian and late early Meramecian for Mississippian rocks from 5,265 to 5,365 feet. Parts of the *Taphrognathus varians–Apatognathus?* Assemblage Zone and the *Gnathodus texanus–Taphrognathus* Assemblage Zone are recognized from this interval.—Author's abstract

10557 **Goldsmith, Louis H.** Some fundamentals of potash geology as a guide to exploration, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. O1–O15, illus., table, 1966.

Practically all potash discoveries to date, except European, have been fortuitous results of oil-well wildcatting. All the continents contain evaporite deposits ranging in age from Cambrian to Pliocene. Primary deposition of evaporites consists of limestone and dolomite, followed by gypsum, then halite which is present until evaporation is completed, and finally the K and Mg salts. Repetitions and disturbances of the cycle occur frequently. Deep burial causes gypsum to change to anhydrite, and the released water moving upward reaches the carnallite-sylvite beds. Solution movement and reprecipitation of dissolved salts is controlled by structure, and may form widespread potash deposits, which may be distinguished by gamma-ray neutron logs.—E.S.L.

00348 **Goldsmith, Richard.** Bedrock geologic map of the New London quadrangle in Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-574, scale 1:24,000, sections, 1967.

The map sheet includes a table showing economic uses of certain rocks.—M.C.M.

00349 **Goldsmith, Richard.** Bedrock geologic map of the Niantic quadrangle, New London County, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-575, scale 1:24,000, sections, 1967.

The map sheet includes a table showing economic uses of certain rocks.—M.C.M.

00564 **Goldsmith, Richard.** Bedrock geologic map of the Uncasville quadrangle, New London County, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-576, scale 1:24,000, sections, 1967.

A table on the map sheet shows economic uses of certain rocks.—M.C.M.

Goldthwait, Richard P. *See* Borns, Harold W., Jr. 10464

Gooding, Ansel. *See* Kapp, Ronald O. 10466

10533 **Gorbunova, Z. N.** Clay minerals in the sediments of the Pacific Ocean [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 84–85, 1966.

10343 **Gordon, Robert B.; Nelson, Carl W.** Anelastic properties of the Earth: Rev. Geophysics, v. 4, no. 4, p. 457–474, illus., 1966.

Experiments on sintered oxides indicate that sources of seismic attenuation in order of importance are viscous grain boundary damping, stress-induced ordering, and dislocation damping. If parts of the mantle are partially melted, stress-induced flow of fluid through intergranular channels may cause attenuation. These mechanisms characteristically result in internal friction showing a strong frequency dependence. Scattering is not an important source of attenuation. The variation with depth of internal friction due to thermally activated relaxation mechanism can account for existing data on anelasticity of the Earth. Low attenuation observed below 500 km can result from effect of pressure in decreasing atomic mobility; observed attenuation decrease is not in itself evidence of phase change. Seismic attenuation data do not put useful bounds on the relation of damping and strength of the mantle.—*from* Authors' abstract

00454 **Gott, Garland B., Jr.; McCarthy, J. Howard, Jr.; VanSickle, Gordon H.; McHugh, John B.** Distribution of gold, tellurium, silver, and mercury in part of the Cripple Creek district, Colorado: U.S. Geol. Survey Circ. 543, 9 p., illus., table, 1967.

Geochemical exploration studies were undertaken in the Cripple Creek district to test the possibility that large low-grade gold deposits might be found. Surface rock samples taken throughout the district indicate that the volcanic rocks between the productive veins contain an average of about 0.6 ppm (part per million) gold. In an area about 3,800 feet long and 500 feet wide near the Cresson mine in the south-central part of the district, scattered surface samples show that the rocks contain an average of 2.5 ppm gold, equivalent to two dollars and fifty cents per ton.

Inasmuch as veins that contain more than 2.5 ppm may also exist in the area, systematic sampling by trenching and drilling is warranted.—Authors' abstract

Grantham, Rodney G. *See* Musgrove, Rufus H. 10553

Grantz, Arthur. *See* Jones, David L. 00341

10385 **Green, P. E., Jr.; Kelly, E. J., Jr.; Levin, M. J.** A comparison of seismic array processing methods: Royal Astron. Soc. Geophys. Jour., v. 11, nos. 1–2, p. 67–84, illus., 1966.

Schemes for combining the outputs of the seismograms in an array so as to achieve maximum improvement in signal-to-noise ratio while imposing minimum distortion on the waveform are discussed. The class of linear processors that involves a single delay or a single delay and amplitude weight in each sensor output before summation is reviewed, then the more general class of linear processing involving a linear filtering operation on each output before summation is described. The two principal procedures of this kind are maximum-likelihood and Wiener processing. Results obtained using these various schemes on small numbers of seismometers at installations in Arizona and Montana are presented.—D.B.V.

00484 **Greenwood, W. R.** Mean-dip maps—Indicators of deformation intensity [abs.]: Northwest Sci., v. 41, no. 1, p. 50, 1967.

Greenwood, William R. *See* Morrison, Donald A. 00489

Greenwood, William R. *See* Reid, Rolland R. 00492

10578 **Gronewald, Gail J.; Duncan, Walter W.** Study of erosion along Homer Spit and vicinity, Kachemak Bay, Alaska, Chap. 27 *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 673–682, illus., 1966.

This is a progress report on the Homer Spit Beach Erosion Study. Information is presented regarding the rapid acceleration of the erosion processes due to the subsidence of the Homer Spit during the 27 March 1964 earthquake. The effect on existing groins both before and after the quake are discussed. Immediately after the quake, emergency measures were required to prevent wave and high water damage to existing structures on the Spit. The results concerning the effectiveness of these measures are presented for evaluation, along with the basic data gathered for the erosion study and some of the problems encountered.—Authors' abstract

Groot, Catharina R. *See* Groot, Johan J. 10507

10507 **Groot, Johan J.; Groot, Catharina R.** Marine palynology—Possibilities, limitations, problems: Marine Geology, v. 4, no. 6, p. 387–395, 1966.

In general, pollen and spores are present in the sediments of the deep ocean basins, particularly in deposits of terrigenous origin. Pollen spectra of abyssal sediments reflect the vegetation of adjacent land masses. Deposits of abyssal plains and ocean rises with little local relief, in temperate zones, are most favorable for obtaining a continuous history of vegetational and climatic changes during the Quaternary. The very slow rate of deposition in the ocean basins and the need for large core samples in order to obtain a sufficient number of pollen grains impose a limit on the detail with which the ecological reconstruction can be accomplished. Reworked plant microfossils present difficulties particularly where pre-Quaternary sediments are exposed on the continental shelf or slope.—*from* Authors' abstract

10512 **Groot, Johan J.** Some observations on pollen grains in suspension in the estuary of the Delaware River: Marine Geology, v. 4, no. 6, p. 409–416, illus., tables, 1966.

Pollen spectra of samples of suspended and bottom sediments in the Delaware River estuary represent the regional vegetation of the Basin as a whole rather than local plant communities. There appears to be a relationship between the number of pollen

grains and the quantity of mineral matter in suspension, suggesting that the two types of particles are transported together and in similar fashion, that is, by water currents primarily.—Author's abstract

00619 **Grose, L. T.; Hileman, D. H.; Ward, A. E.** Coal resources of southwestern Utah: U.S. Bur. Mines Inf. Circ. 8326, 78 p., illus., tables, 1967.

The Kanab, Kolob, Kaiparowitz, and Harmony coalfields were studied to determine their potentials as sources of fuel for steam-powered plants generating electricity. If enough water is available, coal from the Kaiparowitz and Kanab fields may compete successfully in supplying the growing utility market in southwestern United States.—E.R.L.

10427 **Guidotti, C. V.** Variations of the basal spacings of muscovite in sillimanite-bearing pelitic schists of northwestern Maine: Am. Mineralogist, v. 51, nos. 11-12, p. 1778-1786, illus., 1966.

The basal spacings of muscovite in schists over a wide area of regional metamorphism in northwestern Maine reflect the metamorphic grade as determined by the mineral assemblages. The data indicate that the muscovites are more K rich above the K feldspar-sillimanite isograd than below it. Anomalous data can be correlated with incomplete or local equilibrium in the rocks. It is proposed that the basal spacings be used to monitor metamorphic conditions and to decipher the relative importance of different physico-chemical variables.—E.Z.

10392 **Gulbransen, Earl A.** Graphite-hydrogen reactions and their importance in geochemistry: Nature, v. 212, no. 5069, p. 1420-1422, tables, 1966.

The possible importance of the graphite-hydrogen reaction and similar reactions in geochemistry is pointed out, and mechanisms are suggested for the formation of the Earth's atmosphere, hydrosphere, and hydrocarbon gases under conditions similar to those found in volcanoes. The proposed model provides the atmosphere and hydrosphere with water, nitrogen, methane, ethylene, acetylene, benzene, toluene, hydrogen, carbon monoxide, and carbon dioxide. Chemical reactions between these gases in the presence of radiation and electrical discharges as proposed by Urey (1952) could then produce the complex organic compounds necessary for the formation of simple forms of life.—D.B.V.

Gunn, Donald W. *See* Sorem, Ronald K. 00394

10423 **Gupta, Umesh C.; MacKay, D. C.** The relationship of soil properties to exchangeable and water-soluble Cu and Mo status in Podzol soils of eastern Canada: Soil Sci. Soc. America Proc., v. 30, no. 3, p. 373-375, tables, 1966.

Soils derived from Permo-Carboniferous rocks were lower in Cu and Mo than the other groups of soils. Significantly higher quantities of Mo were obtained on fine-textured soils and soils having pH values of 6.0 and over. Exchangeable Cu was lower in sandy soils but was not significantly related to soil pH or organic matter.—Editor's brief

00310 **Guthrie, R. D.** Differential preservation and recovery of Pleistocene large mammal remains in Alaska: Jour. Paleontology, v. 41, no. 1, p. 243-246, illus., 1967.

From the thousands of large mammal fossils recovered from placer mining operations in Alaska it is apparent that the probability of recovery is not the same for each skeletal element. Two major factors seem to determine this probability—the size of the element and its composition.—Author's abstract

Gutschick, R. C. *See* Sprinkle, James. 00622

Gutschick, Raymond C. *See* Rodriguez, Joaquin. 00606

Guy, H. P. *See* Rathbun, R. E. 00327

10397 **Guyod, Hubert.** Interpretation of electric and gamma ray logs in water wells: Log Analyst, v. 6, no. 5, p. 29–44, illus., table, 1966.

A typical inexpensive logging program for water wells consists of a Normal or single-electrode resistivity, the SP and, sometimes, gamma ray measurements. Some of the principles underlying the analysis of these logs are reviewed. The usual logging situations are classified into three groups and simple interpretation procedures are outlined for each. Much useful information is provided by these records, especially when they are supplemented by the bit penetration rate and other data. The logs can solve many common ground-water problems. Those, and the ones that they cannot solve, are reviewed.—Author's abstract

10550 **Habib, D.** Distribution of spore and pollen assemblages in the Lower Kittanning coal of western Pennsylvania: Palaeontology, v. 9, pt. 4, p. 629–666, illus., 1966.

Palynological study of the Lower Kittanning coal seam (Middle Pennsylvanian, Allegheny Series, lower Westphalian D) from 15 sampling sites reveals an orderly vertical and geographical distribution. Assemblages characterized by *Densosporites and Punctatisporites* occur in the uppermost zones where the seam is directly overlain by marine and restricted-marine faunal facies, respectively, of the Lower Kittanning shale. The greatest vertical variation of assemblages occurs at these localities. Where the seam is in direct contact with the overlying freshwater facies, however, it is dominated throughout by assemblages rich in Lycospora. Fewer assemblages occur at these localities. Of 140 species in 59 form genera, 33 species are new; two new spore genera, *Spackmanites and Paleospora*, are proposed.—*from* Author's abstract

10644 **Hainsworth, F. N.; Petch, H. E.** The structural basis of ferroelectricity in colemanite: Canadian Jour. Physics, v. 44, no. 12, p. 3083–3107, illus., tables, 1966.

The complete structure of colemanite, in both its nonpolar and ferroelectric phases, has been determined by neutron diffraction. One of the hydrogen atoms of the water molecule and the hydrogen of an adjacent hydroxyl group, which are in a state of dynamic disorder in the nonpolar phase, settle into ordered noncentric positions in the ferroelectric phase. This ordering is accompanied by small displacements of the other atoms from the positions they occupy in the nonpolar phase. Assuming reasonable charge assignments, the magnitude of the spontaneous polarization calculated from the observed positional changes is of the same order of magnitude as the experimental value. On the basis of these results, a model for the atomistic mechanism of the transition to the ferroelectric state is advanced.—*from* Authors' abstract

Hale, Robin C. *See* Carpenter, Robert H. 00443

Hall, E. B. *See* Miller, E. A. 10410

10521 **Hamilton, E. L.** Acoustic reflection reconnaissance in the Gulf of Alaska [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 6], p. 4, 1966.

00567 **Handfield, Robert C.** A new Lower Cambrian Archaeocyatha?: Jour. Paleontology, v. 41, no. 1, p. 209–212, illus., table, 1967.

Acanthopyrgus yukonensis, n. gen., n. sp., from the Lower Cambrian of the Mackenzie Mountains, Yukon Territory, has a segmented, porous, double-walled body. Whorls of spines occur between each segment. It is tentatively concluded that *A. yukonensis* is a member of the Archaeocyatha.—Author's abstract

10384 **Hannan, E. J.** Spectral analysis for geophysical data: Royal Astron. Soc. Geophys. Jour., v. 11, nos. 1–2, p. 225–236, 1966.

The Fourier methods which underlie the statistical analysis of four types of data are presented: (1) stationary time series, (2) homogeneous planar processes, (3) homogeneous processes on a sphere, and (4) a combination of (1) with (2) or (3). The data to be analyzed will be modified by the effects of filtering of the continuous

phenomenon, of discrete sampling of the continuous phenomenon, and of further filtering of the discrete record. These effects are analyzed and discussed. Procedures for estimating the spectrum of the discrete record are described. Signal measurement in noise problems is discussed as a principal example of the final use of these spectral methods.—*from* Author's abstract

Hanor, J. S. *See* Dunham, A. C. 00404

Hansen, Edward. *See* Armstrong, Richard Lee. 10369

10351 **Hansen, H. J., 3d.** Pleistocene stratigraphy of the Salisbury area, Maryland, and its relationship to the lower Eastern Shore—A subsurface approach: Maryland Geol. Survey Rept. Inv. 2, 56 p., illus., tables, 1966.

In a 90 sq mi area around Salisbury, 24 core holes and 15 test holes were drilled to clarify the stratigraphic sequence and Pleistocene history. North of Salisbury a deep paleochannel, the Naylor Mill, was incised during the Illinoian low-sea stand. The red gravelly fluvial facies of the Salisbury Formation fills and overlies the channel. Its gray-white sand estuarine equivalent, the Beaverdam facies, thickens south and east as the red gravelly facies wedges out. The Walston Formation, a time-transgressive tidal marsh facies, overlies the Salisbury. The Parsonsburg Sand, deposited during the high-sea stand between the Sangamon and Wisconsin, reflects transgressive advance of dune sand over the marshes. During the Holocene transgression, fluvial gravels and marsh muds were deposited along the present rivers. Geologic sections, a panel diagram, and 77 well logs are included.—E.S.L.

00329 **Hantush, Mahdi S.** Growth and decay of groundwater-mounds in response to uniform percolation: Water Resources Research, v. 3, no. 1, p. 227-234, illus., table, 1967.

In the artificial recharge of irrigation waters, the response of ground-water mounds to deep percolation is of practical interest. Where the underlying aquifer is infinite in areal extent, the solution of rise and fall of the water table for the circular recharging area is given in terms of a function easily tabulated for a practical range of parameters. Approximate solutions in terms of already tabulated functions are presented also. For the rectangular recharging area the solution function depends on two parameters. This function is tabulated for a wide range of parameters, which affords a means for relatively simple calculation. The solutions are applicable if the rise of water table relative to initial depth of saturation does not exceed 50 percent.—G.D.C.

00330 **Hantush, Mahdi S.** Depletion of flow in right-angle stream bends by steady wells: Water Resources Research, v. 3, no. 1, p. 235-240, illus., table, 1967.

The flow of a stream hydraulically connected to an aquifer can be reduced by nearby pumping wells. Such pumping will either increase infiltration from nearby streams or decrease the natural flow of ground water into the streams, or both. This depletion of stream flow increases perennial yield of the sand to much more than would have been available as ground water alone. Natural streams as well as canals can meet at right angles, such as those in a trellis drainage pattern. Formulas are developed in terms of tabulated functions for estimating rate and volume of such stream depletion by pumping wells, for both domestic and irrigation use.—G.D.C.

Häntzschel, Walter. *See* Rhodes, F. H. T. 10471

Harkrider, David. *See* Press, Frank. 10430

00324 **Harris, William H.** Stratification of fresh and salt water on barrier islands as a result of differences in sediment permeability: Water Resources Research, v. 3, no. 1, p. 89-97, illus., tables, 1967.

Theoretical values are not valid for the relation of fresh-water head to depth of the fresh-water—salt-water interface beneath barrier islands when there is substantial motion of fresh ground water and where sedimentary deposits are not homogeneous or isotropic. Zones of water are stratified, fresh where permeability

is high, salty where it is low. Near Frisco on Hatteras Island, N. C., the chloride concentration varies inversely with relative permeability of aquifers to a depth of about 140 feet, being less than 100 ppm in permeable zones and greater in impermeable zones. The interface position depends on permeability of the sediments at depth, and is affected by fresh ground-water flushing as a result of retreating salt-water saturation, rather than by fresh-water head differences in shallow aquifer systems.—G.D.C.

10379 **Harrison, C. G. A.; Somayajulu, B. L. K.** Behavior of the Earth's magnetic field during a reversal: Nature, v. 212, no. 5067, p. 1193–1195, illus., table, 1966.

An oriented core taken at 14°47.7′ N., 119°51.5′ W. in 4,240 m of water contains material deposited during a period when the geomagnetic field was reversed in polarity. There are no stable directions away from the normal or reversed groups, and samples lying immediately above and below the reversal have the lowest Q factors. The reversal occurred at least in part by a reduction in intensity of the main dipole field which persisted for about 5,000–10,000 years. Whether the dipole field became zero and then increased in the opposite direction, or swung around through 180° is not known, but either change must have occurred in less than 5,000 years.—D.B.V.

10602 **Harrison, J. M.** The geology of Canada [with French summ.], *in* Internat. Conf. Soil Mechanics and Found. Eng., 6th, Montreal, 1965, Proc., V. 3: Toronto, Ontario, Univ. Toronto Press, p. 97–103, illus., 1966.

The ancient Canadian Shield is exposed over 4.5 million sq km. Younger sedimentary rocks thinly bury its extensions in the Hudson Bay region, Arctic islands, St. Lawrence Lowlands, and Interior Plains. Long deep troughs, developed along with volcanism and rapid sedimentation, subsequently rose to form the Cordilleran, older Innuitian, and Appalachian Mountain belts. Their erosion products formed Maritime coal measures, and Tertiary beds of the Cordillera. Continental glaciers scoured bedrock and soils, dropped till and fluvioglacial débris. Recent soils developed under various climatic and topographic controls. Apart from iron in New Quebec–Labrador, exploited mineral deposits lie near the southern and southwestern fringe of the exposed Shield; there are also vast petroleum resources and potash in the Great Plains, and good potential resources in Arctic islands, eastern continental shelf, and western mountains.—G.D.C.

10374 **Harriss, Robert C.; Adams, John A. S.** Geochemical and mineralogical studies on the weathering of granitic rocks: Am. Jour. Sci., v. 264, no. 2, p. 146–173, illus., tables, 1966.

Chemical, mineralogical, and autoradiographic techniques applied to the study of five weathering profiles developed on granitic rocks of Oklahoma and Georgia indicate that mineral stabilities generally follow the expected sequence: plagioclase, biotite, K-spar, quartz, from least to most stable respectively. Kaolinite is the dominant clay mineral in the Georgia profile; both illite and kaolinite are major constituents in the Oklahoma profiles. Stability diagrams indicate that the Georgia surface waters are in equilibrium with kaolinite and the Oklahoma surface waters are in equilibrium with kaolinite and montmorillonite, but not illite. The largest physical and chemical changes occur in the transition from the C- to the B-horizon. Ca and Na are mobilized in the early stages of weathering, whereas K and Rb are concentrated in the relatively stable K-spar.

00614 **Hart, S. R.; Krogh, T. E.; Davis, G. L.; Aldrich, L. T.; Munizaga, F.** Rb/Sr geochronology of granitic rocks southeast of Sudbury, Ontario: Carnegie Inst. Washington Yearbook 65, 1965–66, p. 64–66, illus., 1967.

An isochron age has been obtained for sheared homogeneous granites along the northwest side of the Grenville front in the Sudbury area. Data indicate a disturbed isotropic system but an isochron might be drawn through four of seven analytical points for an age of about 1,750 m.y. Granites are older than about 1,500 m.y., the probable primary age is about 1,700±100 m.y., and they were formed before the time of the last major metamorphism at about 930 m.y. Acceptance of the

1,700 m.y. age implies a time correlation with intrusive granites in the Sudbury region rather than with the time of the Grenville metamorphism.—V.S.N.

00376 **Hart, Stanley R.; Aldrich, L. T.** Fractionation of potassium/rubidium by amphiboles—Implications regarding mantle composition: Science, v. 155, no. 3760, p. 325–327, illus., tables, 1967.

Rb in amphiboles is found to be generally depleted with respect to K. The K/Rb ratios in 50 samples range from 100 to 5,000, averaging 1,120. This fractionation effect holds for K concentrations from 0.05 to 1.5 percent. The K/Rb ratios of abyssal tholeiites do not place unambiguous limits on the K/Rb ratios of the upper mantle, as partial melting of a mantle material such as amphibole peridotite would produce a liquid with a K/Rb ratio higher than in the initial material. Large-scale mineralogical control of trace-element distributions in the mantle could produce trends with depth that are the reverse of those normally attributed to differentiation processes.—D.B.V.

00316 **Harter, Robert D.; Ahlrichs, James L.** Determination of clay surface acidity by infrared spectroscopy: Soil Sci. Soc. America Proc., v. 31, no. 1, p. 30–33, illus., 1967.

A new and simple method for estimating pH at the surface of colloidal particles has been devised. By use of infrared spectroscopy the effect of proximity to a colloidal surface on an organic acid molecule can be ascertained. An intensity ratio of the carboxylate to carbonyl infrared absorption bands (1,550 to 1,610 cm^{-1} and 1,690 to 1,760 cm^{-1} respectively) of organic acids can be used as an indicator of hydrogen ion activity in the compound's environment. Benzoic acid seems to be the best choice for this type of study, since it is not adsorbed by the clay surface in the presence of water. The surface of a Wyoming bentonite seems to be about 100 times more acid than the solution at a pH of about 7.0. As the pH decreases, there is a decreasing difference between surface and the solution pH.—Authors' abstract

00449 **Hartshorn, Joseph H.** Geology of the Taunton quadrangle, Bristol and Plymouth Counties, Massachusetts: U.S. Geol. Survey Bull. 1163-D, p. D1–D67, illus., tables, geol. map, 1967.

The quadrangle is entirely within the Narragansett basin and is underlain by the Rhode Island Formation, composed of sandstone, shale, and conglomerate of Pennsylvanian age. The continental ice of late Wisconsin time covered the area until about 15,000 years ago. Light-gray to pale-yellowish-brown till with a dominantly sandy matrix derived from the local bedrock forms the ground moraine; flow till, with a higher percent of nonbasin rocks, overlies and is interbedded with ice-contact deposits. The arrangement of glaciofluvial and glaciolacustrine deposits indicates stagnation of the retreating ice. Lake deposits, including varved clay, are buried beneath younger outwash plains or swamps. A nearly continuous mantle of eolian sand includes countless ventifacts. Intense frost action in late-glacial time is suggested by ventifacts churned into the congeliturbate.—J.H.H.

Hatcher, J. T. *See* Bower, C. A. 00386

00381 **Hattin, Donald E.** Permian ophiuroids from northern Oklahoma: Jour. Paleontology, v. 41, no. 2, p. 489–492, illus., tables, 1967.

Additional specimens of the Permian ophiuroid *Archaeophiomusium burrisi*, n. gen., are described. The new material shows that the side formerly regarded as oral is aboral, and also shows some of the mouth frame structures. The vertebral ossicles of type material of the species are illustrated.—J.P.

10551 **Havlena, D.** Interpretation, averaging and use of the basic geological-engineering data: Jour. Canadian Petroleum Technology, v. 5, no. 4, p. 153–164, illus., table, 1966.

It is emphasized that the taking, assembling, and averaging of basic data for use in analysis of a petroleum reservoir requires knowledge of many disciplines of

modern geology and petroleum engineering. Various aspects of "static data", which represent direct measurements of static properties of the reservoir or its fluids, are discussed, specifically: porosity, permeability, facies mapping, connate water content, relative permeabilities and capillary pressures, and the least squares method of averaging data. Along with other conclusions it is pointed out that in averaging static reservoir data corroboration should be obtained from such other direct measurements tools as stratigraphy, lithologic, and geophysical log interpretations, and that least squares methods can be applied for eliminating random errors only.—V.S.N.

00510 **Hay, Edward A.** Uniformitarianism reconsidered: Jour. Geol. Education, v. 15, no. 1, p. 11–12, 1967.

Because geology is unique among empirical sciences in its concern with the past, uniformitarianism should be the focal point of the introductory course.—E.S.L.

10486 **Hayden, John W.; Wrucke, Ronald R.** Unsaturated flow through porous media—Experimental investigation, *in* Am. Water Resources Conf., 2d Ann., Chicago, 1966, Proc.: Am. Water Resources Assoc. Proc. Ser., no. 2, p. 340–351, illus., 1966.

In this study for determining desorptive permeability of unconsolidated porous material at any saturation, the method developed requires that only the effective grain size of the material must be determined. On this basis an idealized capillary pressure-saturated curve is obtained from which the permeability is calculated. In accuracy the results are comparable to those obtained by any other method. At present the simpler method is limited to desorptive flow through coarse grained material, but extension of application appears to be possible.—G.D.C.

00516 **Hazel, Joseph E.** *Repandocosta*, a new Cretaceous and Tertiary ostracode genus: Jour. Paleontology, v. 41, no. 1, p. 103–110, illus., 1967.

The new genus *Repandocosta* is described for twelve North American and at least three European ostracode species that have been placed mainly in *Trachyleberidea or Cythereis*. *Cythereis pauca* Schmidt, 1948, is designated as the type species. The new genus has a stratigraphic range in North America of Coniacian to upper Eocene; in Europe it is known from middle Paleocene to upper Oligocene.—Author's abstract

00548 **Hazel, Joseph E.** Classification and distribution of the Recent Hemicytheridae and Trachyleberididae (Ostracoda) off northeastern North America: U.S. Geol. Survey Prof. Paper 564, 49 p., illus., table, 1967.

Eighteen species of Hemicytheridae and thirteen species of Trachyleberididae have been found off northeastern North America. These taxa are classified in nineteen genera and eight subfamilies. Two subfamilies, four genera, and one species are new. The muscle scar patterns possessed by the various taxa of the two families prove to be valuable in separating the families, grouping related genera into subfamilies, and delineating lineages within subfamilies. The complex muscle scar pattern found in most upper Cenozoic genera of the Hemicytherinae is shown to have developed from the Trachyleberidinae in a series of steps that pass through the Thaerocytherinae and Hemicytherinae.—J.E.H.

Heath, G. R. *See* Moore, T. C., Jr. 10378

10632 **Hedgecock, N. E.; Chakravartty, S. C.** Electron spin resonance of Fe^{+3} in cordierite: Canadian Jour. Physics, v. 44, no. 11, p. 2749–2755, illus., tables, 1966.

ESR spectra of Fe^{+3} located at one of the aluminum sites in cordierite have been investigated at *X*- and *K*-band frequencies at room temperature. The spectra exhibit large zero-field splitting and have been fitted to a spin Hamiltonian of orthorhombic symmetry.—*from* Authors' abstract

Hedgecock, N. E. *See* Holuj, F. 10650

Hedges, Charles S. *See* Sowers, George F. 10341

10525 **Heezen, Bruce C.; Hollister, Charles D.; Ruddiman, William F.** Shaping the continental rise by deep geostrophic contour currents [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 66, 1966.

10565 **Helander, Donald P.; Campbell, John M.** The effect of pore configuration, pressure and temperature on rock resistivity, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. W1–W29, illus., tables, 1966.

For six synthetic bead cores and one synthetic sand core, it has been shown conclusively that the relative formation resistivity factor may be correlated versus pressure, at constant temperature, with relative surface area as the third parameter. An equivalent result was obtained with temperature as the variable. A definite trend in the rate of change of the resistivity factor was also noticed as a function of the matrix character.—*from* Authors' abstract

Helfinstine, R. J. *See* Jackman, H. W. 00521

Helfrich, P. *See* Brock, V. E. 10532

10487 **Hem, John D.** Chemical controls of irrigation drainage water composition, *in* Am. Water Resources Conf., 2d Ann., Chicago, 1966, Proc.: Am. Water Resources Assoc. Proc. Ser., no. 2, p. 64–77, illus., table, 1966.

Concentration of dissolved ions in soil and ground water and in drainage effluents of irrigated areas must be maintained within satisfactory limits. Long-term changes in quantities of ions in storage in irrigation areas can be approximately shown by salt-balance calculations. This concept needs to be extensively refined, and more knowledge of the manner in which solute ions circulate is needed before water-quality change can be predicted. Maximum contents of certain ions are controlled by solubilities of calcium and gypsum, as shown by water from the Gila, Arkansas, and Pecos rivers, and Rio Grande, and also by exchange reactions with soil minerals. A closer union of chemical and physical investigation procedures is needed.—G.D.C.

Hennessy, D. J. *See* Meinschein, W. G. 10627

Henson, W. L. *See* Fetzner, R. W. 10570

10580 **Herbich, John B.; Murphy, H. D.; VanWeele, B.** Scour of flat sand beaches due to wave action in front of sea walls, Chap. 29 *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 705–726, illus., 1966.

The erosion of sand beaches due to oscillatory water particle motion of non-breaking waves can be of importance, particularly where such a beach is fronted by a sea wall supported on spread foundation. Laboratory study was conducted with natural beach sand; waves were generated mechanically. Geometric variables included the inclination of sea walls from 15° to 90° from the horizontal and dynamic variables included ratio of wave length to water depth and wave height to water depth. It has been determined that the "ultimate" depth of scour is a function of wave height and that the location of scour is a linear function of wave length.—Authors' abstract

10355 **Hess, Paul C.** Phase equilibria of some minerals in the K_2O–Na_2O–Al_2O_3–SiO_2–H_2O system at 25°C and 1 atmosphere: Am. Jour. Sci., v. 264, no. 4, p. 289–309, illus., table, 1966.

Phase equilibria in the above system are depicted graphically in terms of the parameters log K^+/H^+, log Na^+/H^+, and log SiO_2 at 25°C and on the chemistry of the coexisting aqueous phase are used to construct the phase diagram. Two phase boundaries are based on recent laboratory investigations by Hemley (1959) and Hemley, Meyer, and Richter (1961). The results show that K-mica, K-spar,

montmorillonite, and phillipsite are all stable in an environment chemically equivalent to that existing in oceanic sediments. The kaolinite field is favored by lower alkali/OH^+ ratios while gibbsite is restricted to systems that contain extremely low silica values, probably less than 1 ppm. Albite and analcite are indicative of high log Na^+/H^+ concentrations.—*from* Author's abstract

00401 **Hewett, D. F.; Radtke, A. S.** Silver-bearing black calcite in western mining districts: Econ. Geology, v. 62, no. 1, p. 1–21, illus., tables, 1967.

Black calcite is clear calcium carbonate containing abundant finely and unsystematically dispersed manganese oxides. Two types of occurrence are late Cretaceous or early Tertiary replacements of Paleozoic carbonate rock, and late Tertiary crustified vein fillings in mid-Tertiary volcanic rocks. The first type accompanies jasper and quartz, the second chalcedony or opal, suggesting higher and lower temperatures, respectively. Prominent minor metals of the first type are Zn, As, Th, and Ag, the latter exceeding 10 oz/t in the oxide residues. Metals in the second type are Pb, Cu, W, As, Th, with very little Ag. The silver is present as argentian manganates. Most is hypogene, some probably supergene.—W.S.W.

00419 **Hewitt, D. F.** Uranium and thorium deposits of southern Ontario: Ontario Dept. Mines Mineral Resources Circ. 4, 76 p., 1967.

This mineral inventory briefly describes 124 deposits of uranium and thorium in southern Ontario. Most of these deposits are pegmatitic in character, although some are metasomatic replacements and vein deposits. Work was done on these deposits principally during the uranium rush of 1954–1957. Four properties produced uranium valued at 105,141,819 dollars from 1956–1964.—Author's abstract

00509 **Hewitt, Philip C.** Why study geology?: Jour. Geol. Education, v. 15, no. 1, p. 8–10, 1967.

The people who study geology are divided into three groups: junior and senior high school students, undergraduate and graduate college students, and earth science and geology teachers. The secondary school students usually take courses in geology or earth science either from an honest interest in the subject or from a desire for an easy science course. The same reasons often exist for undergraduate study. It is suggested that geology should be studied because of its importance as a cultural subject, so that people are aware of the world around them. Geology should be for everyone.—E.S.L.

10441 **Heyl, Allen V.; King, Elizabeth R.** Aeromagnetic and tectonic analysis of the Upper Mississippi Valley zinc-lead district: U.S. Geol. Survey Bull. 1242-A, p. A1–A16, illus., 1966.

Aeromagnetic surveys of the central part of the Upper Mississippi Valley zinc-lead district suggest a Precambrian basement. Mafic plutons probably lie in the basement in the northern part of the district and metasedimentary rocks in the southern part. Faults probably controlled structures in overlying Paleozoic strata and provided channels for heated solutions that mingled with connate waters in the strata and then deposited ores above faults and on the flanks of buried monadnocks.—A.V.H.

Hickman, J. B. *See* Baldwin, W. F. 10548

Hileman, D. H. *See* Grose, L. T. 00619

10652 **Hill, J. Gilmore.** Petrology and provenance of sandstones of the Stanley Group (Mississippian), southern Ouachita Mountains, Oklahoma, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 112–124, 1966.

The Stanley sandstones, from petrographic study of 109 thin sections, were found to be quartz-feldspathic-arkosic wackes, and quartz-feldspathic arenites. It is mostly fine sand of coarse silt size, and sorting is poor, with matrix averaging 18 percent. Mineralogic analyses indicated some quartz derived from pre-existing sediments and some from metaquartzites; plagioclase feldspar is identical to that

in the Stanley tuffs. Rock fragments are rare but the bulk of those found are metamorphics and volcanics. It is concluded that the Stanley source area was an orogenic island system of complex terrain, formed within the Ouachita geosyncline south of the present day mountains. The similarity to subsurface Paleozoic lithologies along the Luling overthrust front in Texas suggests that this buried sequence was a part of the Stanley source area.—G.D.C.

00527 **Hill, Walter E., Jr.** Copper in redbeds of south-central Kansas, *in* Short papers on research in 1966: Kansas Geol. Survey Bull. 187, pt. 1, p. 13–14, illus., 1967.

A study was made of the copper content of the Ninnescah Shale and the Milan Dolomite Member of the Wellington Formation in south-central Kansas. Five east-west sampling traverses were made across the outcrop in a four-county area. Channel samples numbering 411 were analyzed by X-ray spectroscopy for copper. The copper, as the mineral malachite, was found to be the highest (6.65 percent Cu as the metal) in the Runnymede Sandstone Member of the Ninnescah Shale in Harper County, Kans.—Author's abstract

Hills, D. L. *See* Ackroyd, E. A. 00458

Ho, A. M. *See* Takasaki, K. J. 10339

00557 **Hoar, Florence Grosvenor; Bowen, Zeddie Paul.** Brachiopoda and stratigraphy of the Rondout Formation in the Rosendale quadrangle, southeastern New York: Jour. Paleontology, v. 41, no. 1, p. 1–36, illus., tables, 1967.

The formation in its type area was deposited in very shallow water, in subtidal, intertidal, and supratidal environments, with fossils accumulating shoreward of a near-shore bar or bank, unfossiliferous laminated carbonates accumulating seaward and undergoing penecontemporaneous dolomitization. Type sections of the Wilbur and Rosendale Members, and a reference section for the Glasco Member, are proposed. Fourteen brachiopods, one colonial coral, and one bryozoan are described and illustrated, none new. The Rondout is correlated with the Cobleskill Formation of central New York, the Decker Formation of New Jersey, the *Eccentricosta jerseyensis* Zone of the Keyser Limestone of Maryland, West Virginia, and Pennsylvania. Its age is judged to be Late Silurian.—*from* Authors' abstract

00417 **Hodges, Arthur L., Jr.** Ground-water favorability map of the Otter Creek basin, Vermont: [Montpelier, Vt.] Vermont Dept. Water Resources, scale about 1 in. to 2 mi., table, text, 1967.

Information presented is based on a limited amount of data and is intended as a guide for local exploration; further studies are recommended for a more detailed appraisal of the Otter Creek basin. Well and test-boring data indicate the presence of several thick deposits of water-bearing sand and gravel; numerous areas of thin deposits occur throughout the basin. Low to moderate amounts of ground water can be obtained from well points installed next to most streams not flowing directly on a rock floor. Nineteen wells producing water from sand and gravel have an average yield of 114 gpm; six wells producing water from bedrock average 14 gpm.—M.C.M.

00480 **Hoffer, Jerry M.** The Rock Creek flow of the Columbia River Basalt: Northwest Sci., v. 41, no. 1, p. 23–31, illus., 1967.

The Rock Creek flow in Idaho, a thick porphyritic basalt containing intratelluric plagioclase phenocrysts, can be divided by morphologic and textural features into two major units. Variation in grain size of groundmass plagioclase crystals and proportion of associated glass indicate variations in cooling rate during or after extrusion of the lava. The lower unit is fine-grained at top and base, coarse in the middle; the upper unit is entirely coarse-grained, probably due to slow cooling near surface in the vent followed by extrusion of a partially crystallized magma. The scoriaceous flow top in several local sections suggests that extrusion was interrupted by change in amount or direction from source. At Rice Creek, absence of such scoria reflects a continuous period of eruption.—G.D.C.

Hofmann, R. B. *See* Morrison, P. W. 10599

Holbrook, Drew F. *See* Sterling, Philip J. 10646

Holcomb, Lee D. *See* Armstrong, Augustus K. 00370

10475 **Holdaway, M. J.** Hydrothermal stability of clinozoisite plus quartz: Am. Jour. Sci., v. 264, no. 8, p. 643–667, illus., tables, 1966.

The relative stability of the assemblages clinozoisite–quartz and epidote–grossularite–anorthite have been determined between 1 and 4 kb using a rate technique in which the reaction is monitored with a single crystal of one of the participating phases. Clinozoisite and quartz react fractionally forming progressively more iron-rich epidote with anorthite and grossularite garnet as temperature rises. Between 1 and 7 kb, the relation $T=533.6+34.5\ P-0.6\ P^2$ (T° C, P kb) provides the best clinozoisite–quartz dehydration curve. Iron-rich epidote is stable with quartz at least 32° above clinozoisite–quartz. Results indicate that where grandite and anorthite occur at the expense of clinozoisite and quartz in high grade Barrovian metamorphic rocks, temperatures must have exceeded 675° C if $P_{tot} \geq 6$Kb, $P_{water} \geq 1/2\ P_{tot}$.—*from* Author's abstract

00347 **Holden, John C.** Late Cenozoic ostracodes from the drowned terraces in the Hawaiian Islands: Pacific Sci., v. 21, no. 1, p. 1–50, illus., tables, 1967.

Late Cenozoic ostracodes from extensive submarine terraces in the Hawaiian Islands ranging in depth from 260 to 355 fathoms resemble, in part, modern shallow water faunas of the Hawaiian and tropical Pacific islands. Of the 35 species from the terraces, 13 are described as new. These are: *Cytherelloidea monodenticulata, Bairdia kauaiensis, B. hanaumaensis, B. ritugerda, Hemicythere obesa, Mutilus oahuensis, M.(?) coalescens, Jugosocythereis venulosus, Quadracythere hornibrooki, Loxoconcha batei, L. condyla, Cletocythereis bradyi, and Neocaudites terryi.* The assemblage indicates an original shallow water environment for the terraces. Most of the extant species, which also occur as fossils from the terraces, live at depths less than 50 fathoms in present oceans, and only one is reliably reported as living deeper than 160 fathoms; several are known littoral forms.—Author's abstract

00534 **Holland, F. D., Jr.; Feldmann, Rodney M.** A new species of cassiduloid echinoid from the Fox Hills Formation (Upper Cretaceous) of North Dakota: Jour. Paleontology, v. 41, no. 1, p. 252–255, illus., 1967.

A single well preserved specimen of a cassiduloid echinoid from the Timber Lake Member of the Fox Hills Formation (Maestrichtian, Upper Cretaceous) in south-central North Dakota, forms the basis of a new species of the Faujasiidae, *Hardouinia waagei.* The association of this form with *Ophiomorpha* major (Lesquereux) indicates, in this area, that this part of the Fox Hills Formation was deposited near the boundary of the littoral and sublittoral zones.—Authors' abstract

10537 **Holland, Heinrich D.** On time variations in the chemical composition of ocean water [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 10, 1966.

Hollister, Charles D. *See* Heezen, Bruce C. 10525

10650 **Holuj, F.; Thyer, J. R.; Hedgecock, N. E.** ESR spectra of Fe^{+3} in single crystals of andalusite: Canadian Jour. Physics, v. 44, no. 3, p. 509–523, illus., tables, 1966.

The spectra have been investigated at *X*- and *K*-band frequencies at room temperature, and have been interpreted on the assumption that Fe^{+3} occupies the two inequivalent Al^{+3} sites in andalusite. The spectra show large zero-field splitting. The constants of the conventional orthorhombic spin Hamiltonian which fit the spectra are given for sites I and II. A study of the intensities of ESR signals due to site I follow a pattern predicted by theory. The implications of these results are considered briefly.—*from* Authors' abstract

Hood, D. W. *See* Sharma, G. D. 10539

Hopkins, David M. *See* Buffington, Edwin C. 10530

Hopkinson, E. C. *See* Youmans, A. H. 10559

10623 **Houston, R. S.; Toots, Heinrich; Kelley, James C.** Iron content of fossil bones of Tertiary age in Wyoming correlated with climatic change: Wyoming Univ. Contr. Geology, v. 5, no. 2, p. 1–18, illus., tables, 1966.

The iron content of Tertiary bones from Wyoming varies with age, the older bones generally having a higher content. The changes are not strictly proportional to age, but are step-like, and, thus, time is rejected as the controlling factor. Instead climatic changes operating through soil-forming processes are proposed as the main cause of variations in iron content; other factors may have a modifying effect. A study of Tertiary bones interred under conditions of warm humid climate supports the interpretation of climatic control as does the regional pattern of iron content in bones of Upper Miocene of North America.—*from* Authors' abstract

00605 **Howe, Herbert J.; Reso, Anthony.** Upper Ordovician brachiopods from the Ely Springs Dolomite in southeastern Nevada: Jour. Paleontology, v. 41, no. 2, p. 351-363, illus., 1967.

Diceromyonia ignota (Sardeson), *Hypsiptycha cf. H. anticostiensis* (Billings), and *Lepidocyclus capax* (Conrad) are described. The specimens come from the upper 16 feet of the Ely Springs Dolomite (Middle?, Upper Ordovician) in the Pahranagat Range of southeastern Nevada. This horizon also contains *Bighornia* sp. and *Catenipora cf. C. gracilis* Hall. Comparison of the brachiopod species with related forms known elsewhere in North America indicates that the faunule is of Upper Ordovician age. *Diceromyonia* Wang occupies an intermediate position between the families Rhipidomellidae and Dalmanellidae.—Authors' abstract

10434 **Howell, Paul.** Sources of information useful in searching for oil and gas in Kentucky, featuring a selected bibliography with special index maps: Frankfort, Ky., Kentucky Dept. Commerce, 180 p., illus., 1966.

This report was prepared for the use of geologists, geophysicsts, and operators who wish to acquaint themselves with sources of information on the State's oil and gas exploration picture and potential. The contents are arranged by subject groups of sources of basic data and geological material, with some nonessential information in the appendix, as follows: sources; drillers' logs; instrument logs and log libraries; samples and cores, with index map of location; statistical information; well report data; and photogeologic maps. In addition there is a selected bibliography on Kentucky geology. The index maps are to a variety of maps showing well or pool locations, structural contours, and areal geology. A special geoscience library is described.—G.D.C.

00499 **Huang, W. H.; Walker, R. M.** Fossil alpha-particle recoil tracks—A new method of age determination: Science, v. 155, no. 3766, p. 1103–1106, illus., table, 1967.

The discovery of a new type of fossil nuclear track in mica is reported. This track is produced by the recoil nucleus accompanying the α-particle decay of uranium and thorium impurities. The tracks are very short and can be seen with phase contrast microscopy. Measurement of fossil α-recoil track densities, coupled with determinations of the thorium and uranium contents, provides a new dating technique analogous to the previously discovered "fission-track method." The primary advantage of the α-recoil method is a several-thousand-fold increase in sensitivity over the fission-track technique. The α-recoil method should also prove useful in studying the problem of extinct isotopes in the meteorites.—Authors' abstract

Hubbell, D. W. *See* Prych, Edmund A. 10579

00530 **Hunt, Allen S.** Growth, variation, and instar development of an agnostid trilobite: Jour. Paleontology, v. 41, no. 1, p. 203–208, illus., table, 1967.

Quantitatively defined instars through meraspid and holaspid development have been recognized within the Middle Ordovician agnostid trilobite *Trinodus elspethi* (Raymond, 1925) [from Edinburg Limestone, Virginia]. The quantitative definition of instars has permitted study of several aspects of growth, variation, and instar development. Size has been found to increase by a constant geometrical amount and weight may have doubled between successive instars. Molting within the meraspid period was observed to occur without the release of a segment. Evidence presented here indicates that the growth of *T. elspethi* did not continue throughout life but terminated after a fixed number of instars.—Author's abstract

10418 **Hurst, F. J.; Crouse, D. J.; Brown, K. B.** Recovery of thorium (and uranium) from granitic rocks: U.S. Atomic Energy Comm. Rept. ORNL-3987, 85 p., illus., tables, 1966.

Many large granite formations in the United States contain thorium and uranium at concentrations appreciably greater than the average of about 12 ppm thorium and 3–4 ppm uranium for granitic and related rocks. In particular the Conway granite of New Hampshire has 56±6 ppm thorium and about 1/4 to 1/3 as much uranium. The outer 1,000 feet of the main Conway mass is estimated to contain about 35 million tons of thorium and 8–12 million tons of uranium, approximately 2/3 of which are recoverable by ordinary processing methods. Attempts to preconcentrate the thorium and uranium minerals by gravity or magnetic separation were only partly successful, and do not appear to be competitive with direct acid treatment of the granite. Estimated recovery costs are included.—*from* Authors' abstract

Hutt, Jeremy R. *See* Berg, Joseph W., Jr. 10360

10574 **Inman, Douglas L.; Frautschy, Jeffery D.** Littoral processes and the development of shorelines, Chap. 22 *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 511–536, illus., 1966.

Basic principles bearing on the nature of beaches and processes that act to modify them are considered in the light of present coastal development demands. A working hypothesis is developed that applies the principle of the conservation of mass to the mechanics of granular-fluid media. This hypothesis appears to have general application to sand transport processes in the littoral zone. Additional research must be done to provide basic information in some critical areas before application can be made with assurance.—Authors' abstract

00618 **Ireland, H. A.** Preparatory technique for microfossils and inorganic insoluble residues: Jour. Paleontology, v. 41, no. 2, p. 523, 1967.

In order to prevent binding of acid residues by mineral salts during drying it is recommended that residues be flushed with distilled water after washing with tap water, then rinsed with alcohol or acetone, which is then allowed to evaporate, followed by a sharp tap on the receptacle to free the individual particles.—J.F.M.

00378 **Irvine, T. N.** Chromian spinel as a petrogenetic indicator—Pt. 2, Petrologic applications: Canadian Jour. Earth Sci., v. 4, no. 1, p. 71–103, illus., table, 1967.

Crystallization of chromium-bearing spinel from silicate magmas is examined. Applying Irvine's theory (1965) to principal occurrences, it is concluded that varieties known as chromite generally formed simultaneously with olivine, until a peritectic reaction led to formation of pyroxene. More problematical aluminum-rich varieties evidently occur only in alpine-type peridotite bodies and nodules in basaltic volcanic rocks. There is a rough correlation between the Mg/Fe ratios of chromian spinels, olivine, and pyroxenes in the same rock bodies; distribution coefficients of spinel-silicate pairs may be sensitive to temperature. Chromites of stratiform intrusions reflect an appreciable range of oxygen fugacity, spinels of alpine-type peridotite a low one. Exceptionally high ratios reflect ultramafic magmas extremely poor in silica.—G.D.C.

10479 **Irving, E.; Brown, D. A.** Reply to Stehli's discussion [of 1964 paper, 1966] of labyrinthodont abundance and diversity: Am. Jour. Sci., v. 264, no. 6, p. 488-496, illus., 1966.

The labyrinthodont and paleomagnetic record for the Late Paleozoic strongly support the idea that latitudes have changed greatly and are therefore consistent with the hypothesis of continental displacement. Although they are not necessarily correct, the authors do not believe they can be held mistaken for the reasons given by Stehli (ibid., p. 481-487). Whether or not the hypothesis of latitude change is generally correct does not depend upon this single case, but on whether similar inter-disciplinary studies of other climatic indicators are inconsistent or consistent with it.

00521 **Jackman, H. W.; Helfinstine, R. J.** A survey of the coking properties of Illinois coals: Illinois Geol. Survey Circ. 412, 27 p., illus., 1967.

Illinois coals from the mining areas and all the commercially mined seams in the state have been evaluated for their ability to produce both chemical and metallurgical coke. They have been coked both by themselves and in blends, and it has been found that many of these coals that are not suitable for metallurgical coke because of their ash and sulfur content might be used to produce chemical coke where these impurities are not too critical.—Authors' abstract

00476 **Jackson, Togwell A.** Fossil actinomycetes in Middle Precambrian glacial varves: Science, v. 155, no. 3765, p. 1003-1005, illus., 1967.

Fossil actinomycetes and other bacteria have been found in sulfide minerals from "varved" argillites in the middle Precambrian Cobalt Series of Canada. The fossils consist of branched and unbranched nonseptate hyphae and chains of rod-shaped cells. The presence of actinomycetes is consistent with the theory that the argillites are lacustrine deposits.—Author's abstract

10648 **Jacoby, R. S.** Geology of Baskatong Reservoir area (east half), Labelle and Montcalm counties [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 558, 9 p., table, geol. map, 1966.

This area, in the Grenville Precambrian province, is underlain by metasedimentary rocks intermixed with large gneissic complexes. One large body of porphyritic quartz monzonite and an abundance of small unmetamorphosed diabase dikes are present. Folded and highly metamorphosed, many of the rocks have suffered severe cataclastic deformation. The structural trend in the northern two thirds of the area is northeast, in the south it is east, and in the northeast quarter a large marble zone centered in Piscatosine Lake is the core of a synclinal fold with quartzite and biotite gneisses on the limbs. Disseminations of pyrite and pyrrhotite occur in the paragneisses, and of magnetite in the heterogeneous gneiss and migmatite complex. Sand and gravel river terraces are sources of road material.—G.D.C.

10472 **Jeletzky, J. A.** Comparative morphology, phylogeny, and classification of fossil Coleoidea: Kansas Univ. Paleont. Contr. [42], Mollusca, art. 7, 162 p., illus., 1966.

Shell morphology of fossil forms of the cephalopod subclass Coleoidea (= Dibranchiata) is critically restudied and compared with that of Recent Coleoidea and fossil Bactritida and Orthocerida. Special attention is paid to microscopic structure of the phragmacone. These studies are preliminary to the forthcoming Coleoidea volume of the "Treatise on invertebrate paleontology." The resulting phylogenetically oriented classification system contains these orders: Aulacocerida, Carboniferous-Jurassic, the most primitive belemnite-like forms; Phragmoteuthida, somewhat less primitive, considered ancestral to all the following: Teuthida; Octopida; Sepiida; Belemnitida. Diagnoses of new or considerably emended taxa are given; new genera *Mojsisovicsteuthis, Buelowiteuthis, Groenlandibelus*, are formally erected to make them eligible for inclusion in the Treatise.—V.M.J.

Jenkins, F. A., Jr. *See* Crompton, A. W. 00475

00485 **Jenson, Lawrence E.; McKanna, Blaine.** Sedimentology of a gravel spit in southern Puget Sound [abs.]: Northwest Sci., v. 41, no. 1, p. 52–53, 1967.

10432 **Jepsen, Glenn L.** Early Eocene bat from Wyoming: Science, v. 154, no. 3754, p. 1333–1339, illus., tables, 1966.

A new species of bat, *Icaronycteris index* of the suborder Microchiroptera, is described, from the Green River Formation of Wyoming. This is the oldest known flying mammal. The bones show a few primitive characteristics such as clawed index finger and complete phalangeal formula, but the bat was fully developed—an anatomically precocious contemporary of the dog-sized polydactylous horse.—D.B.V.

00405 **Johannes, Wilhelm.** A mechanism for the emplacement of magnesite in dolomite [discussion of paper by P. E. Rosenberg and J. W. Mills, 1966]: Econ. Geology, v. 62, no. 1, p. 148–149, 1967.

Johnson, A. I. *See* Morris, D. A. 00353

10453 **Johnson, J. Harlan.** The Cambrian algal flora: Palaeobotanist, v. 14, nos. 1–3, p. 19–25, illus., tables, 1966.

The fossil record of Cambrian algae, mainly calcareous forms, is reviewed. Most of the evolutionary development took place before the Cambrian; all phyla were apparently already present. To date 59 genera have been described from the Cambrian (23 Lower, 21 Middle, at least 26 Upper), represented by 142 described species. These genera are tabulated, with stratigraphic distribution from Precambrian through Upper Ordovician and number of species. Another table shows distribution of genera by regions: Siberia, U.S., Canada, Mexico, France, Russia, Italy, Antarctica, Australia, and North Africa. Algae were unusually important as rock builders during the Cambrian (notably the blue-green stromatolite building algae), having little or no competition from limestone building animals.—V.M.J.

10451 **Johnson, J. W.; Eagleson, P. S.** Coastal processes, [Chap.] 9 *in* Estuary and coastline hydrodynamics: New York, McGraw-Hill Book Co. (Eng. Soc. Mons.), p. 404–492, illus., tables, 1966.

This textbook chapter reviews sources and characteristics of beach material, modes of transport and losses of material, quantitative analysis of transport processes, characteristics of beach deposits and of the equilibrium beach, and sediment problems at coastal structures. The general character and magnitude of oceanic and estuarine currents are considered in longshore and onshore-offshore sediment movement, and the principal features and uses of quantitative analyses are discussed, as well as methods of sampling and measurement of statistical distributions of beach deposits. Classification of beach profiles in the offshore zone is tabulated, and the sorting of sediments is described. Typical shoreline examples illustrate changing configuration and sediment problems with man-made structures.—G.D.C.

10575 **Johnson, J. W.** Nearshore sediment movement—Central California coast, Chap. 23 *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 537–559, illus., 1966.

An 80-mile reach of the central California coast, extending from the mouth of the Russian River in the north to Half Moon Bay in the south, was studied for the characteristics of sediment movement in the nearshore zone. From the results of a large number of beach and offshore sediment samples and other information, several techniques were utilized in appraising the nature of sediment movement along the reach of the coastline under study. These techniques included: (a) the physical nature of the coastline from a consideration of the prevailing wave energy, (b) the distribution of light and heavy minerals and their sources, (c) the use of certain naturally radioactive minerals and their use as a tracer, and (d) the sedimentation experience at harbors where both natural and stabilized entrances exist.—Author's abstract

10630 **Johnson, Kent E.** A depositional interpretation of the Stanley Group of the Ouachita Mountains, Oklahoma, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 140–163, illus., 1966.

The Stanley Group, widespread in the Ouachitas, is the axial portion of a flysch deposit about 10,000 feet thick, largely of shale. Deposited below wave base in normally quiet water in a reducing basin, fauna was meager and mainly microscopic. During widespread quiescent conditions, there was largely silica deposition and skeletal accumulation. Volcanism is revealed by tuffaceous sediments. Sand was frequently carried into the basin by turbidity currents triggered by instability failure associated with rapid subsidence of the trough and accompanying uplifts of the source areas. Paleocurrent markings show a strong trend to the northwest and west; the main source area was southeast, in a series of anticlinal ridges along the southern margin of the geosyncline. —G.D.C.

00325 **Johnson, Vernon; Cutshall, Norman; Osterberg, Charles.** Retention of ^{65}Zn by Columbia River sediment: Water Resources Research, v. 3, no. 1, p. 99–102, illus., tables, 1967.

Less ^{65}Zn is displaced from Columbia River sediments by the interaction of sea water than can be removed by leaching with solutions of certain first transition series metals. We interpret this to mean that ion exchange is not an important mechanism in the retention of ^{65}Zn in these samples. Instead, much of the ^{65}Zn is held by 'specific sorption.' Neither treatment displaced ^{51}Cr or ^{46}Sc from the sediments, whereas about one-third of the ^{54}Mn was removed upon contact with sea water.—Authors' abstract

Jones, Bill. *See* Antoine, John, 00361

00374 **Jones, C. T.; Cooper, B. Land, Jr.** Thomas Witt Leach (1896–1966): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 436–437, portrait, 1967.

00341 **Jones, David L.; Grantz, Arthur.** Cretaceous ammonites from the lower part of the Matanuska Formation, southern Alaska: U.S. Geol. Survey Prof. Paper 547, 49 p., illus., tables, 1967.

Cretaceous fossils from the lower part of the Matanuska Formation in south-central Alaska are mainly ammonites and *Inoceramus*. Twenty species of ammonites are discussed that range in age from Albian to Turonian. The lower part of the Matanuska Formation ranges in age from Albian to Coniacian or Santonian. It is both structurally and lithologically complex, and correlation within the depositional basin rests heavily on paleontological control. Within the Matanuska Valley–Nelchina area, the lower part of the formation is divided into three sequences, northern, central, and southern, which are bounded by two major faults. Considerable lateral movement may have occurred along these faults, with the resulting juxtaposition of unlike sequences of rock.—D.L.J.

00456 **Jones, Francis T.** Refractive index determination for liquids by crystal rotation: Microscope and Crystal Front, v. 15, no. 8, p. 309–313, illus., 1967.

When the liquid in which a crystal is immersed has a refractive index that lies between the upper and lower limiting indices of the crystal, appropriate rotation of the crystal will achieve a position for which the refractive index of the crystal matches that of the liquid. Attempts to make a refractometer by relating the angular position of a crystal (e.g. calcite) to its refractive index will be reported.—Author's abstract

Jones, Gary E. *See* Pearson, John E. 10356

10361 **Jones, Robert L.; Beavers, A. H.** Weathering in surface horizons of Illinois soils: Soil Sci. Soc. America Proc., v. 30, no. 5, p. 621–624, illus., 1966.

Lines analogous to isohyets were drawn with respect to molar ratios of CaO, K_2O, and Fe_2O_3 to ZrO_2. The resulting maps demonstrate the close relationship of loess

thickness to intensity of soil development, and identify a north–south band of soils in southern Illinois that are the most intensely weathered soils in the State. The youngest or least developed soils identified by the lines occur in thick loess deposits of extreme northwestern Illinois. Isoweathering lines cannot be drawn in the area of Wisconsin drift because of the precontemporaneity of loess on the drift and many local sources within the drift sheet area.—Authors' abstract

Jones, Robert L. *See* Ahmad, N. 10400

10589 **Jungerius, P. D.** Age and origin of the Cypress Hills plateau surface in Alberta [with French abs.]: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 8, no. 4, p. 307–318, illus., tables, 1966.

The surface of the Cypress Hills plateau, usually regarded as a remnant of a Tertiary erosion level, is here shown to be an altiplanation surface formed by mass-wasting processes during the Wisconsin glacial stage, and covered by material of aeolian origin. Scattered occurrences of a truncated reddish palaeosol indicate the remnants of an older surface dating from an early interglacial stage. These conclusions are based on evidence from the soil profile, the grain-size distribution and the clay and heavy mineral analysis of a representative section.—Author's abstract

10417 **Jungmann, William L.** Geology and ground-water resources of Neosho County, Kansas: Kansas Geol. Survey Bull. 183, 46 p., illus., tables, geol. map, 1966.

Sedimentary rocks of Cambrian, Ordovician, Devonian(?), Mississippian, Pennsylvanian, Tertiary, and Quaternary ages overlying the Precambrian basement complex in Neosho County have a thickness of 2,100 feet. Pennsylvanian, Tertiary, and Quaternary rocks are exposed to a thickness of 700 feet. Structure is controlled by the Prairie Plains monocline. Wells in Pennsylvanian consolidated rocks yield less than 1 gpm of water from limestone and shale aquifers to more than 30 gpm from sandstone. Water from consolidated aquifers is highly mineralized, that from sandstones softer and less mineralized. Wells within Pleistocene deposits yield up to 30 gpm. Chief use of ground water is for domestic and stock purposes, whereas all municipal systems use treated surface water. Estimated total use of ground water in 1961 was 109 million gals (334 acre-feet).—*from* Author's abstract

10364 **Jurinak, J. J.** Surface chemistry of hematite—Anion penetration effect on water adsorption: Soil Sci. Soc. America Proc., v. 30, no. 5, p. 559–562, illus., table, 1966.

The adsorption of water by hematite, using high vacuum techniques, was studied. The surface of hematite was pre-treated with phosphate, sulfate, or molybdate and activated at various temperatures. The anion treatment had no apparent effect on the physical adsorption of water. Water adsorption on OH sites is inferred. About 45 to 47 percent of the oxide surface was found to physically adsorb water. Chemisorbed water was influenced by anion treatment and was related to both density of OH population and mobility of the associated proton.—G.D.C.

00355 **Kachadoorian, Reuben; Yerkes, R. F.; Waananen, A. O.** Effects of the Truckee, California, earthquake of September 12, 1966: U.S. Geol. Survey Circ. 537, 14 p., illus., table, 1967.

The Truckee earthquake had a magnitude of 5.4 on the Richter scale and was felt over an area extending from San Francisco eastward to Salt Lake City and from Bakersfield northward beyond Chico, Calif. Ground breakage due to seismic shaking occurred in unconsolidated alluvium along a zone about 10 mi long and its concentration suggests it may be related to a subsurface northeastward-trending fault rather than to buried extensions of the northwestward-trending faults dominating regional geologic structure. Other effects include: damage to dams, minor damage to bridges, slumps or landslides along highways, damage to buildings, damage by falling rocks to a powerhouse and railroads, minor damage to water wells and water distribution systems, and rejuvenation of springs.—*from* Authors' abstract

00380 **Kanamori, Hiroo.** Spectrum of P and PcP in relation to the mantle–core boundary and attenuation in the mantle: Jour. Geophys. Research, v. 72, no. 2, p. 559–571, illus., tables, 1967.

Spectrum analyses of records of the short-period vertical component of P and PcP phases obtained by the Tonto Forest array for 21 earthquakes with $\Delta = 47°$ to 83° show that the trace amplitude ratio of PcP to P generally is significantly larger than the theoretical ratio, and the pulse width of PcP narrower than that of P. Both these facts can be explained by taking into account an appropriate attenuation distribution in the mantle. The Q distribution for P-waves is found to be about the same as for S at the period of about 1 sec. It is calculated that the major discontinuity at the mantle–core boundary is sharp and probably less than 1 km thick. The possibility of a soft layer terminated by a sharp boundary cannot be ruled out.—D.B.V.

00426 **Kanamori, Hiroo.** Comparison of gravity interpretation methods: Jour. Geophys. Research, v. 72, no. 2, p. 583–587, illus., 1967.

Applicability of the weighting function method to gravity problems is discussed as compared with the exact method. The merits of the weighting function method are its simplicity and rapidity of computation, particularly in three-dimensional problems. For local geological problems, the weighting function method can be used for the gravity calculation with sufficient accuracy when the structure is appropriately approximated by surface density distributions. The gravity inversion by use of the weighting function method is outlined and illustrated for the water layer correction of gravity. The method is useful in relating the gravity data, without introducing detailed structures, to other geophysical data such as seismic and heat flow data.—Author's abstract

10638 **Kansas Geological Society.** Flysch facies and structure of the Ouachita Mountains—29th field conference, 1966, Guidebook: Wichita Kans., Kansas Geol. Soc., 278 p., illus., tables, geol. maps, 1966.

The 29th Field Conference includes field stops selected to stress stratigraphic and structural principles; to observe marginal marine strata, showing upright tree molds in the Arkoma Basin and also shelf and upper slope environments to provide a comparative model for the interpretation of flysch facies. The source, direction and mode of transportation, and lithic characteristics of varieties of flysch are explained and related to depositional environment. Both local and regional structural components show the relationship between sedimentation and tectonics. New evidence for nappe structures in the Arkansas and Ouachitas are presented. Nine technical papers are cited individually.—G.D.C.

10466 **Kapp, Ronald O.; Gooding, Ansel.** Revision [of 1964 paper]—Sunbeam prairie pollen profile: Am. Jour. Sci., v. 264, no. 9, p. 743–744, 1966.

Recent C-14 dates establish an age of 11,850±100 B.P. for the Two Creeks forest instead of 11,400 years as previously reported. Thus, the climatic cooling which marked the end of the Two Creeks interstadial occurred prior to 11,850; the Valders ice passed over the Two Creeks site at least 450 years earlier than previously assumed, and a segment of the Sunbeam Prairie bog pollen diagram which had been presumed to date from the Two Creeks interstadial is clearly from the Valders stadial.

00337 **Kaula, W. M.** Theory of statistical analysis of data distributed over a sphere: Rev. Geophysics, v. 5, no. 1, p. 83–107, illus., table, 1967.

The problem of obtaining a representation of a variable on a sphere from irregularly distributed observations is divided into two topics (1) spectral representation: the relationships between covariances, spherical harmonic coefficients, power spectra, and so forth; and (2) statistical analysis: extrapolation, power spectrum, and coefficient determination, and so forth, under the assumption of stationarity. The relationships of various techniques are discussed.—Author's abstract

Kaula, W. M. *See* Lee, W. H. K. 00425

10358 **Kayser, Robert B.** Bituminous sandstone deposits, Asphalt Ridge, Uintah County, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 19, 62 p., illus., tables, geol. map, 1966.

Asphalt Ridge is the second largest bituminous sandstone deposit in the Uinta basin; concentrations occur in the Cretaceous Rim Rock Sandstone (Mesa Verde Group), the overlying Eocene Uinta Formation, and the Oligocene Duchesne River Formation. With the new in situ thermal recovery method, this occurrence may become economically important. The thick uniform sands of the Mesa Verde Group contain reserves of nearly 700 million bbl with 350 million recoverable; physical and chemical properties are shown in a tabulation of analyses. Origin of the bitumen is unknown. Physical properties of the reservoir rocks are discussed as a controlling factor in production. Bituminous substances are classified in a table, and seven well logs are given in the appendix.—E.S.L.

10393 **Keller, G. V.; Anderson, L. A.; Pritchard, J. I.** Geological Survey investigations of the electrical properties of the crust and upper mantle: Geophysics, v. 31, no. 6, p. 1078–1087, illus., 1966.

The electrical properties of rocks in the deep crust and upper mantle have been studied by means of conventional resistivity surveys, magnetotelluric surveys, and measurements of electrical properties of rocks at high temperatures. A heterogeneous surface layer consisting of sedimentary rocks and weathered igneous and metamorphic rocks is recognized. A marked decrease in resistivity sometimes observed at about 10 km within the crust may correspond to the Conrad discontinuity. No electrical boundary can be recognized at depths corresponding to the M-discontinuity, but a marked decrease in resistivity occurs between 60 and 100 km.—D.B.V.

10567 **Keller, George V.** Statistical studies of electrical well logs, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. AA1–AA19, illus., 1966.

A statistical study of resistivity logs is being made to provide control for surface-based electrical geophysical surveys. The analysis consists of tabulating probability density curves for values of resistivity chosen randomly from a log, followed by computation of various moments describing the resistivity density curves. These moments, or averages, were computed for thick sections, usually several thousand feet thick, rather than for individual formations. Characteristic patterns were found for the probability density functions, and these patterns were found to persist from well to well. Over larger distances, the patterns show slow trends. It is tempting to correlate these patterns and their trends with the stratigraphy and geologic history of the sedimentary column [in the Denver basin].—Author's abstract

00608 **Keller, W. D.; Gentile, Richard J.; Reesman, A. L.** Allophane and Na-rich alunite from kaolinitic nodules in shale: Jour. Sed. Petrology, v. 37, no. 1, p. 215–220, illus., tables, 1967.

Allophane and Na-rich alunite have been developed from kaolinitic nodules in Pennsylvanian-age shale in Bates County, Mo., by action of supergene sulphate solutions derived from oxidizing iron sulphide.—*from* Authors' abstract

Kelley, James C. *See* Houston, R. S. 10623

Kellum, Lewis B. *See* Whitney, Marion I. 10428

Kelly, E. J., Jr. *See* Green, P. E., Jr. 10385

Kennedy, G. C. *See* Kitahara, S. 10373

00566 **Kesling, Robert V.** Edrioasteroid with unique shape from Mississippian strata of Alberta: Jour. Paleontology, v. 41, no. 1, p. 197–202, illus., 1967.

Lispidecodus plinthotus, new genus and species of edrioasteroid, is so unusual that a new family is proposed for it. No lineage is known leading to this edrioasteroid. It was found in the Canadian Rockies of Alberta and probably came from the Banff Limestone. To emphasize the unique morphology of the Lispidecodidae, a key is offered to all edrioasteroid families, including Pyrgocystidae, n. fam. This key, based on current knowledge of general external characters, probably does not portray phylogenetic relationships.—*from* Author's abstract

10657 **Kesling, Robert V.** *Botryocrinus niemani*, a new crinoid from the Middle Devonian Silica Formation of Ohio: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 9, p. 271–275, illus., 1966.

Botryocrinus niemani, sp. nov., resembles two other Middle Devonian species, *B. reimanni* Goldring from the Wanakah Shale of western New York and *B. arkonensis* Goldring from the Arkona Shale of Ontario. It differs from *B. reimanni* in having stronger and more complex ornamentation on the plates of the dorsal cup, shorter *IBB*, and wider *RR* facets, and from *B. arkonensis* in having a nearly round column and more complex ornamentation on the cup plates. In addition, the holotype of the new species is slightly larger than any described specimen of *B. reimanni* and nearly twice the size of the largest known specimen of *B. arkonensis*.—*Author's abstract*

10577 **Kidby, Harold A.; Oliver, John G.** Erosion and accretion along Clatsop Spit, Chap. 26 *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 647–671, illus., 1966.

The study area encompasses 18 miles of Oregon coastline known as Clatsop Beach, which lies between the Columbia River south jetty and Tillamook Head, south of Seaside, Oregon. The physical changes (including man-made changes such as jetty construction which was initiated in 1885) that have occurred in the area since 1792 are described and presented graphically. Theories based on an analysis of the very complex joint function of sand supply and incident wind, oceanographic, and estuarine forces are proposed as the cause of erosion and accretion over the long-time span.—Authors' abstract

King, Elizabeth R. *See* Heyl, Allen V. 10441

King, John M. *See* Berg, Joseph W., Jr. 10360

10617 **Kinney, Douglas M.** (compiler). Geology—Natl. Atlas Sheet 74–75: Washington, D.C., U.S. Geol. Survey, scale 1:7,500,000, 1966.

Kirby, J. R. *See* Zietz, Isidore. 00464

00507 **Kisslinger, Carl.** The International Institute of Seismology and Earthquake Engineering: Jour. Geol. Education, v. 15, no. 1, p. 3–5, 1967.

In 1960–61 the Government of Japan operated an International Training Center of Earthquake Engineering for 15 participants from 10 countries. Since Sept. 1963 it has been supported by the UN Special Fund, and the name was changed as above. The support consists of fellowships for half the participants, now totaling 26, and services of UNESCO experts in seismology and earthquake engineering. All trainees have college degrees, but the actual level of preparation varies, the greatest lack being in mathematics and physics. The aim is to prepare the participants to provide services needed in their own countries.—E.S.L.

10373 **Kitahara, S.; Takenouchi, S.; Kennedy, G. C.** Phase relations in the system MgO–SiO_2–H_2O at high temperatures and pressures: Am. Jour. Sci., v. 264, no. 3, p. 223–233, illus., tables, 1966.

Phase assemblages were determined at water pressures up to 30 kb and temperatures up to 900°C for the following four equilibria: (1) serpentine + brucite = forsterite + vapor: (2) serpentine = forsterite + talc + vapor: (3) forsterite + talc = enstatite + vapor; and (4) talc = enstatite + quartz (or coesite) + vapor. The $dP/dT = \infty$ for equilibria 1, 2, and 4 above 10 kb, and is negative for 3 above

5 kb. The data show that water pressures can be increased to at least 30 kb without the formation of a primary serpentine magma.—H.R.C.

Kitano, Y. *See* Kunze, G. W. 10540

Kitano, Y. *See* Knowles, L. I. 10541

00368 **Klein, George deVries.** Paleocurrent analysis in relation to modern marine sediment dispersal patterns: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 366–382, illus., table, 1967.

In coastal environments, directional coastal structures are fashioned by a combination of tidal, wave- and wind-driven currents which sometimes flow independently from slope and sediment sources. The deltaic environment appears to be the only coastal environment where sediment dispersal is slope dependent. The direction of flow of marine currents on continental shelves and in deep ocean basins are controlled by differences in density reflecting temperature and salinity differences, by wind action, by tidal action, and by rotation of the Earth. Only turbidity currents, slump, and sand flow are characterized by downslope dispersal in deep-sea environments. Complex combinations of ocean currents include those which converge, diverge, and are stratified.—W.C.C.

10613 **Knodel, Paul C.** Soils tests computer programs: U.S. Bur. Reclamation (Water Resources Tech. Pub.) Research Rept. 3, 144 p., illus., tables, 1966.

Electronic computer programs written for numerous soils tests and currently being used by the Soils Engineering Laboratory include: moisture density, gradation analysis, consistency, compaction, permeabilities, triaxial shear, consolidation, and a method of computing least squares for sliding factor and direct shear test. Whenever applicable, output data show both British and metric units. Output data are usually in tabular form and include appropriate summaries. Some programs call for punch card output; all were written in Fortran II language for the IBM-7090 electronic computer. With very minor revisions to the existing programs, they were made to conform to the format required by a Honeywell computer.—*from* Author's abstract

10387 **Knopoff, Leon.** (chairman). Upper Mantle Project—Proposed United States program for 1966–1970: Am. Geophys. Union Trans., v. 47, no. 4, p. 547–553, 1966.

In response to the ICSU recommendations that countries further develop their Upper Mantle Project programs during phase 3 of the project, the United States committee has recommended (1) studies of continental margins and island arcs; (2) studies related to the world rift system; (3) transatlantic geophysical survey, emphasizing the continental margins and Mid-Atlantic ridge; (4) cooperative studies, especially in Latin America; (5) continuation of the worldwide seismic network and global studies based on it; (6) drilling for scientific purposes, on land and sea (including continuation of the Mohole program); and (7) emphasis on analysis, interpretation, publication, and international exchange of results, through the World Data Centers and special symposiums and study groups.—D.B.V.

Knowles, L. I. *See* Kunze, G. W. 10540

10541 **Knowles, L. I.; Kunze, G. W.; Kitano, Y.** Exchangeable cations associated with clay minerals in the Taku estuary of southeast Alaska [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 25, 1966.

Koffman, D. M. *See* VanSchmus, W. R. 00478

10572 **Kohout, F. A.** Submarine springs—A neglected phenomenon of coastal hydrology, *in* Symposium on hydrology and water resources development, Ankara, Turkey, 1966: Ankara, Turkey, Central Treaty Organization, p. 391–413, illus., 1966.

Submarine springs reported from 21 countries or island territories are most frequently in regions of cavernous limestone or lava flows; their existence implies that the landward segment of an aquifer is underdeveloped in terms of its water-yielding potential. Their water may range from fresh to brine, and temperature from cool to very hot. An example of a confined aquifer is 2.5 mi offshore from Crescent Beach, Fla.; one of a non-artesian aquifer is in Biscayne Bay, Miami. There is no hydraulic discontinuity between underground waters beneath land areas and those beneath ocean areas, as is apparent by salt-water intrusion into coastal fresh ground-water aquifers. Thermal submarine springs should occur in lagoons and outer reef tract of coral atolls. The ultimate hoped-for correlation would be a relation between size and intensity of temperature anomalies and quantity of discharge from submarine springs.—M.C.M.

10520 **Kramer, James R.** Chemical composition of oceans in geological times [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 5], p. 11, 1966.

Krogh, T. E. *See* Hart, S. R. 00614

Kruger, S. T. *See* Nir, A. 10413

10473 **Kujawa, Frank B.; Eugster, Hans P.** Stability sequences and stability levels in unary systems: Am. Jour. Sci., v. 264, no. 8, p. 620–642, illus., table, 1966.

Diagrams of stable and metastable equilibria in unary systems are derived by projecting pressure–temperature–Gibbs free energy models onto the pressure-temperature plane. For each point on this plane there exists a stability sequence, which is defined as a sequence of all the phase assemblages possible at that point, arranged in order of increasing stability. Phase assemblages with comparable relative stabilities are combined into stability levels, the first of which is the stable phase diagram. A unary system with ϕ phases has ϕ stability levels. A single pressure-temperature–Gibbs free energy model suffices for the derivation of diagrams for each $\phi \leq 5$, but many models are necessary for each $\phi > 5$.—Authors' abstract

Kullerud, Gunnar. *See* Yund, Richard A. 10485

10540 **Kunze, G. W.; Knowles, L. I.; Kitano, Y.** The distribution and mineralogy of clay minerals in the Taku estuary of southeast Alaska [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 24, 1966.

Kunze, G. W. *See* Knowles, L. I. 10541

00435 **LaBerge, Gene L.** Microfossils and Precambrian iron-formation: Geol. Soc. America Bull., v. 78, no. 3, p. 331–342, illus., 1967.

Petrographic studies reveal that spheroidal and ellipsoidal structures, ranging from 5 to 40μ in diameter, of possible organic origin including some believed to be relict microfossils are extremely abundant in many Precambrian iron formations in the United States, Canada, Australia, and South Africa. Particular types of structures are present in widely separated districts, indicating a wide geographic distribution. Distinctive forms occur in Proterozoic iron formations in North America and in an Archean iron formation in Australia.—J.P.A.

Lamey, C. A. *See* Bayley, R. W. 10407

10642 **Lang, Robert C.** The Pennsylvanian rocks of the Lake Murray area, *in* Pennsylvanian of the Ardmore Basin, southern Oklahoma—Ardmore Geol. Soc., Field Conf., 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., p. 13–18, illus., tables, 1966.

The geologic history of the Pennsylvanian is reviewed, beginning with the Chester Goddard Shale and Springer Formation of Chester or lowest Pennsylvanian age. Members of the Dornick Hills, Deese, Hoxbar, and Cisco Groups are described.

and their surface-subsurface correlation discussed. A diagrammatic cross section across the area accompanies the paper.—E.S.L.

00399 **Langston, Wann, Jr.** The thick-headed ceratopsian dinosaur *Pachyrhinosaurus* (Reptilia:Ornithischia), from the Edmonton Formation near Drumheller, Canada: Canadian Jour. Earth Sci., v. 4, no. 1, p. 171–186, illus., 1967.

Pachyrhinosaurus, hitherto known from the lower Edmonton facies of the Lethbridge district of Alberta, has recently been discovered in correlative rocks in the Red Deer River valley, near Drumheller. An incomplete skull cf. *P. canadensis* Sternberg is better preserved than others previously described. It reveals basic resemblances between this genus and certain ceratopsids with short squamosals, deep faces, and wide uncomplicated narial apertures; the frill was fenestrated. *Pachyrhinosaurus* is best placed in the Ceratopsidae, where it is unique in the possession of a massive nasofrontal boss in place of the usual nasal horn.—*from* Author's abstract

Langway, C. C., Jr. *See* Crozaz, G. 10416

10457 **LaRocque, Aurèle.** Pleistocene Mollusca of Ohio, Pt. 1 (of 4 pts.): Ohio Div. Geol. Survey Bull. 62, pt. 1, p. 1–111, illus., 1966.

In the two introductory chapters, the nature of Pleistocene nonmarine faunas, classification of Ohio Pleistocene mollusks, stratigraphic interpretation of assemblages, collecting and laboratory methods, distribution records, and geologic setting of the Ohio Pleistocene (Kansan through Wisconsin) are summarized. In Chap. 3, basic assumptions in paleoecologic interpretation are discussed and molluscan assemblages of Ohio and other States are listed by Pleistocene stages, followed by comparative living assemblages in Ohio and northern States. In all lists, the species are grouped by naiad pelecypods, sphaeriid pelecypods, fresh-water gill-breathing gastropods, fresh-water lung-breathing gastropods, and land gastropods; abundance data are given where available. Distribution maps and systematic descriptions will appear in Pts. 2–4 of Bull. 62.—V.M.J.

10571 **Larson, Lawrence T.** Mineral resources summary of the Graves Spring quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 8 p., tables, 1966.

This text accompanies Tennessee Div. Geology Geol. Map GM 41-SW, by R. H. Barnes, R. E. Lounsbury, and G. K. Moore, 1966 (cited separately). The only mineral commodity mined in the Graves Spring quadrangle is chert, residual deposits of which were formed by deep weathering of the silicious Fort Payne, Warsaw, and St. Louis Limestone, of Mississippian age. All pits are in the Fort Payne residuum which ranges in thickness from 15 to more than 40 feet in pit faces. Mined chert has been used as road base or fill material; most secondary roads in the area are surfaced with chert. Reserves are extensive. Potential resources are iron ore and gravel.—M.C.M.

00424 **Lasky, B. H.** Earth heat flow criteria may indicate porosity traps: World Oil, v. 164, no. 5, p. 92–99, 106, illus., 1967.

An alteration study of the Black Lake area, Natchitoches Parish, Louisiana, indicates a significant, intense alteration anomaly over Black Lake field. Since there is no structural closure on the top of the Lower Cretaceous Pettit (producing zone) datum, the anomaly is evidently due to heat flow and temperature changes resulting from thermal conductivity differences of nonporous and porous limestones and of limestones with pores filled with gas, oil and water. Criteria established may contribute to a breakthrough in the search for stratigraphic traps.—Author's abstract

Latta, Bruce F. *See* Foley, Frank C. 10502

10543 **Laughlin, Charles P.** Records of wells and springs in Baltimore County, Maryland: Maryland Geol. Survey Water Resources Basic Data Rept. 1, 403 p., illus., tables, 1966.

The records of 5,265 wells and 48 springs were gathered from 1945–64; locations are shown on 50 maps covering all of Baltimore County. Tables show crystalline

and sedimentary rocks and their water-bearing properties. Water commonly occurs in joints, crevices, and related fractures of crystalline rocks, with the upper few hundred feet of earth material constituting the ground-water reservoir. In unconsolidated deposits, water occurs in pore spaces of the sand and gravel; large amounts of ground water are stored in these aquifers.—M.C.M.

Laughlin, Charles P. *See* Slaughter, T. H. 10544

00344 **Laycock, William A.** Distribution of roots and rhizomes in different soil types in the Pine Barrens of New Jersey: U.S. Geol. Survey Prof. Paper 563-C, p. C1-C29, illus., tables, 1967.

Root and rhizome systems of selected shrubs of the Pine Barrens of the New Jersey Coastal Plain were studied to determine effects on present and future ground-water supplies of changes in forest composition caused by controlled burning. Two species of shrubs (*Kalmia angustifolia and Lyonia mariana*) in the transition zone between upland and lowland areas have phreatophytic characteristics; their roots penetrate as deep as 40–58 inches to reach the underlying water table. Roots of other species of shrubs may or may not extend to the water table. The highest total numbers of roots in the entire profile were found in soils having thin, imperfectly leached A_2 horizons. A decrease in shrub cover caused by controlled burning, and the resultant decrease in roots, might permit more water to reach the water table.—*from* Author's abstract

00425 **Lee, W. H. K.; Kaula, W. M.** A spherical harmonic analysis of the Earth's topography: Jour. Geophys. Research, v. 72, no. 2, p. 753–758, tables, 1967.

In 1964–65 visual estimates were made of the percentage of land, average land elevation, and average ocean depth in each $1°\times1°$ square and of percentage of lake and ice and average lake depth and ice thickness in each $5°\times5°$ square, using published charts. The values for the $1°\times1°$ squares were averaged to form the mean values for $5°\times5°$ squares which were then used for a spherical harmonic analysis of the Earth's topography, to $n=36$. The results indicate an appreciable improvement in accuracy and detail of description of the topography over previously published analyses.—D.B.V.

10382 **Lee, W. H. K.; Taylor, P. T.** Global analysis of seismic refraction measurements: Royal Astron. Soc. Geophys. Jour., v. 11, no. 4, p. 389–413, illus., tables, 1966.

Results of worldwide refraction measurements are summarized with the aid of statistical methods. Average crustal thickness is about 35 ± 2 km for continents and 8 ± 0.2 km for oceans; it is thinnest for ocean ridges and increases toward the continents. Average upper mantle P_n velocity is essentially the same everywhere. There is a good correlation between depth to the M-discontinuity and elevation/depth, between crustal thickness and elevation/depth, but no significant correlation between upper mantle P_n velocity and elevation/depth, between depth to the M-discontinuity and upper mantle P_n, and between crustal thickness and upper mantle P_n velocity.—D.B.V.

00354 **LeGrand, H. E.** Ground water of the Piedmont and Blue Ridge provinces in the Southeastern States: U.S. Geol. Survey Circ. 538, 11 p., illus., tables, 1967.

Yields of individual wells in the Southeastern States vary greatly within distances as short as 100 feet, making estimates of potential yields difficult. Point values are assigned to topographic conditions and soil thickness and are used to rate a site to estimate percent chance of success of a well; however, this system is not intended to be precise. Simple clear cut statements about the water-yielding properties of the various types of rocks are not easy to make. Some heavily pumped wells tend to decline gradually in yield; it may be wise to drill no deeper than 150 feet if the yield is poor, or no deeper than 300 feet in almost all cases. The water table continuously fluctuates and reflects changes in underground storage. Generally the water ranks high in chemical quality. Serious attention should be given to possibility of water contamination by waste.—M.C.M.

00429 **Lehnert-Thiel, Klaus.** Erfahrungen bei der Prospektion im kanadischen Schild: Montan Rundschau, v. 15, no. 3, p. 43–48, illus., 1967.

Based on the author's experience, the problems of prospecting in the Canadian Shield are summarized, including selection of territory, size of group, equipment, methods, observations, climate and environment.—G.D.C.

10505 **Leonhardy, Frank C.; Anderson, Adrian D.** The archaeology of the Domebo site, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie Plains: Mus. Great Plains Contr., no. 1, p. 14–26, illus., 1966.

A mammoth, *Mammuthus imperator*, was presumably killed and butchered in a canyon, now known as Domebo Canyon, about 11,200 years ago, as indicated by two reliable radiocarbon dates on the bone and two on wood from the lower member of the Pleistocene Domebo Formation. The animal died on marshy, though fairly solid, ground. The remains were soon covered by fine sand and then clay. Three projectile points were found associated with the remains; the two complete points are classed as Clovis, though one is aberrant. The Domebo site is assigned to the Llano Complex, thereby extending the known distribution of the complex to the eastern margin of the Great Plains. The radiocarbon dates are consistent with dates from other mammoth kill sites in the southern Plains and Southwest, such as Blackwater Draw, Naco, Lehner, and Dent.—*from* Authors' summary

10598 **Leonhardy, Frank C.** Late Pleistocene research at Domebo—A summary and interpretation, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie-Plains: Mus. Great Plains Contr., no. 1, p. 51–53, 1966.

Paleoecology and paleoclimatology of the Domebo site, Domebo Canyon, Caddo County, Okla., during late Wisconsin Pleistocene time (10,000 to 11,500 years ago), have been reconstructed from studies of geomorphology, stratigraphy, archeology, vertebrate and invertebrate faunas, and palynology. Comparisons with data from other archeological sites and with present conditions suggest that not only was the late Wisconsin climate more moderate than the present climate, with somewhat more available moisture, but climatic conditions were more uniform throughout the southern Great Plains. The principal archeological significance of the Domebo site is that the association of mammoth and Clovis projectile points extends the distribution of the Llano Complex to the eastern margin of the southern Great Plains.—V.M.J.

10414 **Lerman, A.** Boron in clays and estimation of paleosalinities: Sedimentology, v. 6, no. 4, p. 267–286, 1966.

The uptake of B by some clays is proportional to its concentration in solution and takes place in a relatively short time. Na borate in the marine water apparently facilitates B adsorption by the clays. The pre depositional history of the clays, differences in the properties of clay mineral polymorphs, and adsorption of B from interstitial waters make interpretation of paleosalinity based on B in clays ambiguous.—G.M.F.

Levin, M. J. *See* Green, P. E., Jr. 10385

10478 **Lilly, H. D.** Late Precambrian and Appalachian tectonics in the light of submarine exploration on the Great Bank of Newfoundland and in the Gulf of St. Lawrence—Preliminary views: Am. Jour. Sci., v. 264, no. 7, p. 569–574, 1966.

Submarine bedrock has been directly examined both east and west of the island of Newfoundland in an attempt to locate both sides of the Appalachian fold belt. A band of almost flat lying Silurian strata, running parallel to and within a few miles of the west coast of the island, indicates that the Appalachian fold system ends abruptly between two and eight miles off shore. On the Great Bank of Newfoundland, the lithology and structural trends of the Ballard Bank, Virgin Shoals, and Eastern Shoals suggest that the Great Bank is geologically much like the Avalon Peninsula, except along its southern flank where fairly recent sediments have accumulated.—Author's abstract

10561 **Lindseth, R. O.** Application of signal theory to well log interpretation, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. S1–S21, illus., 1966.

Digital computers are useful for the standard methods of well log computation, and provide a powerful tool for the development of new methods of well log analysis; one of the most promising areas of study appears to be in the application of signal theory techniques. Limitations of the computer method are recognized, and a number of existing applications, including formation log simulation, correlation, and inverse filtering, are reviewed; possible future applications are discussed.—E.S.L.

Linebaugh, Reta E. *See* Dutton, Carl E. 00351

10348 **Linehan, Daniel.** Lithospheres, *in* Planetology and space mission planning—Sec. 1, Environments: New York Acad. Sci. Annals, v. 140, art. 1, p. 93–98, illus., 1966.

Results of seismology, seismic surveys, magnetic and gravity measurements, and heat flow determinations are compared and balanced to obtain the most suitable model of the Earth's crust. Composition of the continental crust varies with depth; thickness ranges from 30 to 60 km. Oceanic crust is 5–10 km thick. Major unstable areas are listed, and arcuate tectonics and isostasy are reviewed.—E.S.L.

Lingenfelter, R. E. *See* Nir, A. 10413

10469 **Lipman, Peter W.** Water pressures during differentiation and crystallization of some ash-flow magmas from southern Nevada: Am. Jour. Sci., v. 264, no. 10, p. 810–826, illus., table, 1966.

Water pressures between approximately 500 and 1,200 bars during differentiation and crystallization of source magmas for 6 Tertiary rhyolitic ash-flow sheets from southern Nevada are indicated by plots of 82 chemical analyses in the experimentally determined system $NaAlSi_3O_8$–$KAlSi_3O_8$–SiO_2–H_2O. These pressures are considerably lower than most previously estimated for rhyolitic magmas. The water pressures also provide some basis for estimating water content, temperature, and depth of the magmas during differentiation and crystallization.—Author's abstract

00382 **Lipps, Jere H.; Ribbe, Paul H.** Electron-probe microanalysis of planktonic Foraminifera: Jour. Paleontology, v. 41, no. 2, p. 492–496, tables, 1967.

Microprobe analysis is made of the minor elements substituting for calcite in 12 specimens of 8 species of planktonic Foraminifera. Only magnesium, iron, and strontium are believed to be chemically combined in the carbonate tests. Aluminum, silicon, and titanium were detected as contaminants, but results for manganese were inconclusive.—J.F.M.

00383 **Lipps, Jere H.; Lipps, Karen L.** Phyletic affinities of the foraminiferan *Tremachora* n. gen. (Tremachoridae N. Fam.): Jour. Paleontology, v. 41, no. 2, p. 496–499, illus., 1967.

Upper Miocene rocks of California have yielded a single species different in external morphology and wall microstructure from any representatives of existing genera or families. The new genus and family erected to receive this form are placed in the superfamily Cassidulinacea on the basis of the granular wall and basic test coiling. It is most similar to the families Caucasinidae and Delosinidae and these similarities may indicate a close phyletic relationship.—J.F.M.

Lipps, Karen L. *See* Lipps, Jere H. 00383

10399 **Liu, T. K.; Odell, R. T.; Etter, W. C.; Thornburn, T. H.** A comparison of clay contents determined by hydrometer and pipette methods using reduced major axis analysis: Soil Sci. Soc. America Proc., v. 30, no. 6, p. 665–669, illus., tables, 1966.

The reduced major axis method was used to express the linear relationship between clay contents determined by hydrometer and pipette analyses on 155 duplicate soil

samples from Illinois and 10 other states. The resulting equation ($Y = 0.63 + 1.008X$, in which X and Y represent the pipette and hydrometer clay content, respectively) and highly significant correlation coefficients indicate that clay contents determined by these two methods are quite similar.—Editor's brief

00427 **Lliboutry, L.** Discussion of paper by J. Weertman, "Sliding of nontemperate glaciers" [1967]: Jour. Geophys. Research, v. 72, no. 2, p. 525–526, 1967.

A more realistic model than that used by Weertman (ibid., p. 521–523), considers bedrock to be covered with large protuberances covered with smaller ones, which in turn are covered with still smaller ones, and so on. With this model, which gives up the idea of a "controlling obstacle size," Weertman's objections are no longer valid. Ice cannot overflow the minute projections.—D.B.V.

Lloyd, R. M. *See* Russell, K. L. 00359

Lodder, W. *See* Beets, D. J. 00365

Lodge, J. P., Jr. *See* Cadle, R. D. 00433

00340 **Logan, Malcolm H.; Burton, Lynn R.** Effect of the earthquake of March 27, 1964, on the Eklutna Hydroelectric Project, Anchorage, Alaska: U.S. Geol. Survey Prof. Paper 545–A, p. A1–A30, illus., 1967.

The March 27, 1964 earthquake and its aftershocks caused damage requiring several million dollars worth of repair to the Eklutna Hydroelectric Project, 34 mi NE of Anchorage. Electric service from the powerplant was interrupted during the earthquake's early phase, but was restored (intermittently) until May 9 when it was closed for inspection and repair. Primary damage was at the intake structure in Eklutna Lake; no damage to the power tunnel was observed. Most damage occurred to facilities constructed on unconsolidated sediments and overburden which densified and subsided during the quake; structures built on bedrock experienced little or no damage. Most damage to underground communication and electrical systems in Anchorage (examined with a television camera) was concentrated at or near valley slopes; those parts of the systems within the major slide areas of the city were destroyed.—*from* Authors' abstract

10585 **Løken, O. H.; Andrews, J. T.** Glaciology and chronology of fluctuations of the ice margin at the south end of the Barnes Ice Cap, Baffin Island, N.W.T.: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 8, no. 4, p. 341–359, illus., tables, 1966.

Investigations of Barnes Ice Cap, including mass balance measurements on the cap, airphoto analysis of adjacent glacial deposits, and lichenometric studies along the southwest margin, reveal contrasts between the northeast and southwest sides. Drifting results in asymmetric snow accumulation and a negative budget on the southwest relative to the northeast. Precipitation is much greater over the icecap than over adjacent areas. It is suggested that a proto-Barnes Icecap must have existed during the Hypsithermal, as subsequent climatic deterioration was insufficient to redevelop an icecap. Distribution of terminal moraines indicates that part of the south dome slumped recently and confirms the northeastward migration of the icecap. Chronology of ice-margin fluctuations over the last 1,200 years and comparisons made with the margin elsewhere show the cap has retreated.—E.S.L.

Long, Leland Timothy. *See* Berg, Joseph W., Jr. 10360

00486 **Long, William A.** Comparative glacier photographs from Cascade Pass [abs.]: Northwest Sci., v. 41, no. 1, p. 54, 1967.

00439 **Longwell, Chester R.; Mound, Michael C.** A new Ordovician formation in Nevada dated by conodonts: Geol. Soc. America Bull., v. 78, no. 3, p. 405–411, illus., 1967.

A stratigraphic unit composed of impure carbonate rocks in the Muddy Mountains thrust plate is designated Monocline Valley Formation and is assigned an early

Ordovician age based on conodonts. The type locality of this formation is about 10 miles east of the Sheep Range–Dry Lake Range region, where Ordovician strata are generally similar to those near Eureka.—J.G.V.

10594 **Loring, D. H.; Nota, D. J. G.** Sea-floor conditions around the Magdalen Islands in the southern Gulf of St. Lawrence: Fisheries Research Board Canada Jour., v. 23, no. 8, p. 1197–1207, 1966.

Acoustical, underwater photographic, and sediment sampling data indicate that the major geomorphologic features of the shelf throughout the southern Gulf are not related to present environmental conditions, nor to the St. Lawrence submarine valley. Submarine troughs and tunnel valleys give evidence of extensive Pleistocene glaciation. Sandstone with an intermittent veneer of sediments occurs on the floor between Prince Edward Island and the Magdalen Islands, as well as to the north. In contrast, the shelf areas west and east of the Islands have an almost continuous sediment cover, mainly the erosional products of a former elevated area of which the Magdalen Islands and Bradelle and Orphan Banks are remnants. The ice sheets presumably covered the shelf, lobes invading through main channels. A broad terrace between 28 and 34 fathoms around the Islands marks a shoreline during stillstand in the post-glacial transgression.—E.S.L.

Lounsbury, Richard E. *See* Barnes, Robert H. 10604

10349 **Lowman, Paul D., Jr.** Photography from space—Geological applications, *in* Planetology and space mission planning—Sec. 1, Environments: New York Acad. Sci. Annals, v. 140, art. 1, p. 99–106, illus., 1966.

Several hundred terrain photographs were taken for geological study during the Gemini flights. Six reproduced here include five from the Mexico United States border area around the Colorado River, and one from Arabia. Structures, rock types, and geomorphology are interpreted.—E.S.L.

00487 **Lowther, J. Stewart.** A new Cretaceous flora from southwestern Oregon [abs.]: Northwest Sci., v. 41, no. 1, p. 54, 1967.

00488 **Lund, Ernest H.** Pillow structure in high Cascade "basaltic andesites" [abs.]: Northwest Sci., v. 41, no. 1, p. 55, 1967.

10484 **Lundgren, L. W., Jr.** Muscovite reactions and partial melting in southeastern Connecticut: Jour. Petrology, v. 7, no. 3, p. 421–453, illus., tables, 1966.

A sillimanite–orthoclase isograd crosses the strike of the major Ordovician pelitic schist unit in this area, separating a sillimanite–muscovite zone from a sillimanite–orthoclase zone. Segments of all the Cambrian(?) and Ordovician units in southeastern Connecticut were affected by the reactions of this post-Lower Devonian metamorphism. Temperatures of 650°C are suggested for metamorphism in the sillimanite–orthoclase zone. Migmatites were formed, partly by isochemical elimination of muscovite. Most of them must have developed by partial melting of rocks in which muscovite was being eliminated, and by the intrusion of melt from deeper zones in which biotite was being eliminated. Melting in lower temperature parts of the zone must have been controlled by water released from muscovite.—G.D.C.

Luternauer, John L. *See* Pilkey, Orrin H. 00441

00447 **Mabey, D. R.; Morris, H. T.** Geologic interpretation of gravity and aeromagnetic maps of Tintic Valley and adjacent areas, Tooele and Juab Counties, Utah: U.S. Geol. Survey Prof. Paper 516-D, p. D1–D10, illus., table, geol. maps, 1967.

A 30-milligal gravity low in Tintic Valley indicates that about 7,000 feet of low-density Cenozoic rocks underlie the valley and that normal faults occur on both sides of the valley. A west trending zone of magnetic anomalies indicates a belt of abundant igneous rocks extending beyond the limits of the survey. A large magnetic high over the East Tintic Range is interpreted as reflecting a large intrusive body underlying the south half of the range. Smaller magnetic highs are produced

by intrusive bodies in the Sheeprock and West Tintic Ranges and the Desert Mountains. A zone of high magnetic intensity extends across the southern part of Tintic Valley. The geophysical data show no evidence of a basement uplift in the Sheeprock Mountain area.—D.R.M.

10628 **MacIntosh, J. A.** Geology of Lantagnac–La Touche area, Abitibi territory and Abitibi–East county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 555, 25 p., table, geol. map, 1966.

Rocks of this area are Precambrian, gneisses with intrusive syenodiorite in the northern half and metavolcanic and metasedimentary rocks in the southern half. Steep dips of both bedding and schistosity have consistent strikes within bands of the sedimentary–volcanic rocks; in the variably banded gneisses dips are more moderate. Relationships are uncertain, although on a regional scale Opémisca sedimentary and volcanic rocks overlie a dominantly volcanic sequence, and the gneisses are younger. Later diabasic and gabbroic dikes trend east–northeast to north–northwest. Gold, copper, and nickel have been the main objects of exploration in the area; cobalt and molybdenum and pyrrhotite and pyrite are also reported. Geochemical values for copper, zinc, lead and molybdenum in stream sediments are shown on the accompanying geologic map.—G.D.C.

MacKay, D. C. *See* Gupta, Umesh C. 10423

10455 **Mackay, J. Ross.** Tundra and taiga, *in* Future environments of North America—Conservation Found. Conf., Warrenton, Va., 1965: Garden City, N.Y., Nat. History Press, p. 156–171, illus., 1966.

The tundra is defined as treeless, and the taiga as the transitional open woodland between the tundra and boreal forest; the difficulties of setting boundaries are discussed. Climate, especially summer temperature, is a major factor in tundra development. The active layer of permafrost which underlies nearly all of the tundra, and is discontinuous below the taiga, varies from a few inches to several feet so that ground–water flow is lateral and confined to this layer. Most of the tundra–taiga bears the imprint of recent glaciation, and is characterized by soil instability. Soil displacement forms patterned ground and might be a basis for soil classification; ice–wedge terrain is peculiarly susceptible to change. The possibilities of degrading permafrost by artificial means is discussed.—E.S.L.

10586 **Mackay, J. Ross; Stager, John K.** The structure of some pingos in the Mackenzie Delta area, N.W.T.: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 8, no. 4, p. 360–368, illus., 1966.

Truncation by wave action has exposed horizontal cross sections of some pingos of the Recent Mackenzie Delta. In general, the concentric beds of sand, clay, and peat dip outwards but are frequently cut by both normal and thrust faults. Drilling and digging failed to confirm a clear planoconvex ice core, but extensive ice lensing was encountered. Wave erosion made it possible to examine the exposed ice core of one of the large pingos of the Pleistocene (or older) sediments. It appears that pingo growth probably started less than 3,000 years ago as a result of lake–shoaling which took place over a period exceeding 6,000 years. Drilling indicated that the bottom of the ice core probably lies below the base of the pingo. Ice specimens from two separate sites have the majority of the optic axes oriented toward the centre of the ice core.—Authors' abstract

00392 **Mackenzie, Fred T.; Garrels, Robert M.; Bricker, Owen P.; Bickley, Frances.** Silica in sea water—Control by silica minerals: Science, v. 155, no. 3768, p. 1404–1405, illus., tables, 1967.

Silicate minerals typical of those carried in the suspended load of streams release silica to silica–deficient sea water and abstract silica from silica–enriched sea water. Experimental rates of release and uptake permit the conclusion that the suspended solids carried into the oceans by streams are a major control of the concentration of silica in the ocean.—Authors' abstract

10461 **MacKenzie, Fred T.; Garrels, Robert M.** Chemical mass balance between rivers and oceans: Am. Jour. Sci., v. 264, no. 7, p. 507–525, illus., tables, 1966.

Postulation of a steady-state model for the ocean leads to removal of stream-derived dissolved solids as minerals in marine sediments, as dissolved constituents in sediment pore waters, and as materials cycled through the atmosphere. Disposal of dissolved solids requires reactions of the type: X-ray amorphous Al silicate + quartz + HCO_3 + cations = cation Al silicate + CO_2 + water. Such chemical synthesis implies control of major ion ratios in sea water and CO_2 pressure of the atmosphere by equilibria involving alumino-silicates. These "reverse weathering" reactions, by removing HCO_3 and alkali metals from the oceanic system, prevent it from attaining the composition of a soda lake. Formation of typical clay minerals implies these minerals are in equilibrium with average ocean water and are not significantly altered upon entering the ocean as allogenic particles.—*from* Authors' abstract

10590 **Maddock, Thomas, Jr.** The behavior of straight alluvial channels, *in* Symposium on hydrology and water resources development, Ankara, Turkey, 1966: Ankara, Turkey, Central Treaty Organization, p. 243–268, illus., table, 1966.

The initial step in distinguishing features of water flow in alluvial channels is to determine parameters controlling movement of sediment. Equations developed for relations between velocity and load are considered better than most others and are simple. Effect of a mixture of sediment sizes upon relations among velocity, discharge, and load is uncertain and dependent upon difference between sizes of material in motion and in the bed. Relations among velocity, discharge, depth, and slope are uncertain; the unknown is the friction factor whose wide range of variation is related to changes in bed deformation patterns caused by moving sediment. Within the area of uncertain relations, velocity is related to load; if slope is constant, the friction factor changes to balance velocity-load relation. Application is to two-dimensional flow but relations can be modified for three-dimensional.—M.C.M.

Madsen, James H., Jr. *See* Stokes, William Lee. 10490

10528 **Malloy, R. J.** Vertical crustal movement associated with the 1964 Alaskan earthquake [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 71, 1966.

Malmberg, G. T. *See* Worts, G. F., Jr. 10609

00334 **Mapel, W. J.** Bituminous coal resources of Texas: U.S. Geol. Survey Bull. 1242-D, p. D1–D28, illus., tables, 1967.

Occurrences of coal reported in sample logs of wells drilled for oil and gas are plotted for eight beds in Pennsylvanian, and three in Lower Permian, rocks; this information is combined with published thickness measurements of coal at outcrops to give a new estimate of 5,400 million short tons of bituminous coal inferred to be present in Paleozoic rocks of north-central Texas in beds >14 in. thick and under <3,000 feet of overburden. Inferred deposits (in millions of short tons) are: Eagle Pass district, bituminous, 525; Santo Tomas district, cannel, 115; San Carlos district, bituminous, 25; and Aguja Formation, largely unexplored, 65. The combined total of these estimates is about 6,100 million short tons of bituminous and cannel coal.—*from* Author's abstract

Marcher, Melvin V. *See* Barnes, Robert H. 10605

00498 **Marsal, Raúl J.** Large scale testing of rockfill materials: Am. Soc. Civil Engineers Proc., v. 93, paper 5128, Jour. Soil Mechanics and Found Div., no. SM 2, p. 27–43, illus., 1967.

For the design of El Infernillo Dam in Mexico, triaxial equipment was set up to test rock fragments and alluvial sediments composing the materials for rockfill masses. The most important factor affecting shear strength and compressibility is

particle breakage under stress, which may be correlated with void ratio. Shear strength is larger in well-graded materials with low void ratio, whether alluvial or rock products; variation in strength is probably due to intrinsic characteristics of the particles; strength decreases as particle breakage increases; the influence of void ratio and saturation needs further study.—G.D.C.

10647 **Martin, Helene A.; Rouse, Glenn E.** Palynology of late Tertiary sediments from Queen Charlotte Islands, British Columbia: Canadian Jour. Botany, v. 44, no. 2, p. 171–208, illus., tables, 1966.

Spores, pollen grains, and other microfossils are described from the Skonun Formation of Queen Charlotte Islands, situated off the western coast of British Columbia. The microfossil assemblage, apparently late Miocene to early Pliocene in age, is analyzed and compared with both other fossil floras and the extant flora. Results indicate the presence of distinctive genera and species, some of whose living equivalents are found only in Asia, Central and South America, or eastern North America. The phytogeographic and paleoecologic implications of the microfossils are discussed, and reconstructions are attempted for both the climate and the physiography during the time of deposition.—Authors' abstract

00328 **Matalas, N. C.; Reiher, Barbara J.** Some comments on the use of factor analyses: Water Resources Research, v. 3, no. 1, p. 213–223, illus., table, 1967.

Factor analysis is a technique that purports to explain observed relations among several variates in terms of simpler relations that provide insight into the underlying structure of the variates. The analysis, however, is technically underdeveloped, and its usefulness for studying interrelated hydrologic variates is questionable because of the inherent indeterminacies in the factor model, the lack of knowledge about the sampling properties of the factor loadings, the fact that the factors are not directly observable, and the inability to use the results of factor analyses in other analytic studies.—Authors' abstract

Mathews, W. H. *See* Nasmith, H. 00398

McCarthy, J. Howard, Jr. *See* Gott, Garland B., Jr. 00454

10667 **McConnell, Duncan; Foreman, Dennis W., Jr.** The properties and structure of $Ca_{10}(PO_4)_6(OH)_2$—its relation to tin (II) apatite: Canadian Mineralogist, v. 8, pt. 4, p. 431–436, tables, 1966.

The refractive indices of synthetic hydroxyapatite are omega 1.651 and epsilon 1.647 (both ± 0.002) and the unit-cell dimensions are a 9.416A and c 6.883 (both ± 0.002). Measured and calculated intensities for powder diffraction reflections down to 1.720A are compared. Apatites with complete substitution of stannous ions for calcium ions do not seem to form in hot aqueous solutions, but something approximating $Sn_9Ca(PO_4)_6$ $(OH,F,Cl)_2$ was obtained. Its precise stoichiometry is uncertain. All attempts to produce Zn-substituted apatite resulted in a mixture of phases, one of which usually was hopeite.—Authors' abstract

McDaniel, A. R. *See* Bassett, J. R. 00320

00537 **McDonald, Barrie C.** Surficial geology, Sherbrooke-Orford-Memphremagog, Quebec: Canada Geol. Survey Prelim. Ser. Map 5-1966, scale 1:63,360, 1967.

10383 **McEvilly, T. V.** Crustal structure estimation with a large scale array: Royal Astron. Soc. Geophys. Jour., v. 11, no. 1–2, p. 13–17, illus., 1966.

This note summarizes work in progress in the determination of crustal structure, using the large telemetered seismic array along the coast of central California. The present status of the investigation, azimuthally varying anomalies in $dT/d\Delta$ and direction of approach for teleseismic P-waves have been observed which require regional structural variations equivalent in effect to about 15° of M-discontinuity dip toward the east, with equivalent dipping velocity contrast in the upper mantle. There also appears to be a significant velocity change across the San Andreas fault.—D.B.V.

00436 **McGill, George E.; Sommers, David A.** Stratigraphy and correlation of the Precambrian Belt Supergroup of the southern Lewis and Clark Range, Montana: Geol. Soc. America Bull., v. 78, no. 3, p. 343–351, illus., table, 1967.

Several well-exposed stratigraphic sections of the Belt Supergroup in the southern Lewis and Clark Range were studied and measured in detail. The sections show that the Belt thins to the east or northeast owing both to primary sedimentation and to pre-Middle Cambrian erosion. Correlation of these rocks with the well-known sections near Bonner, Helena, and Glacier National Park suggests that the Helena Formation, Siyeh Formation, and "Newland Limestone" are lateral equivalents.—D.H.W.

McGovern, W. E. *See* Rasool, S. I. 10391

00461 **McGrew, Laura W.** Geologic map of the Antelope Gap quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-619, scale 1:24,000, 1967.

00462 **McGrew, Laura W.** Geologic map of the Bordeaux quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-620, scale 1:24,000, 1967.

00465 **McGrew, Laura W.** Geologic map of the Casebrier Hill quadrangle, Goshen County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-621, scale 1:24,000, section, 1967.

Fossils found in the Arikaree Formation and in terrace gravel and tributary valley alluvium in the Casebrier Hill quadrangle and their ages are listed in a table. M.C.M.

00466 **McGrew, Laura W.** Geologic map of the Ferguson Corner quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-622, scale 1:24,000, 1967.

Fossils found in the Arikaree and White River Formations in the Ferguson Corner quadrangle and their ages are listed in a table.—M.C.M.

00467 **McGrew, Laura W.** Geologic map of the Natwick quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-624, scale 1:24,000, 1967.

Fossils found in the Natwick quadrangle (horse, snails, clam) in the upper part of the Arikaree Formation and their possible age determinations are listed in a table.—M.C.M.

00468 **McGrew, Laura W.** Geologic map of the Squaw Rock quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-626, scale 1:24,000, 1967.

00469 **McGrew, Laura W.** Geologic map of the Wheatland quadrangle, Platte County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-627, scale 1:24,000, 1967.

McHugh, John B. *See* Gott, Garland B., Jr. 00454

McKanna, Blaine. *See* Jenson, Lawrence E. 00485

00390 **McKenzie, K. G.; Swain, Frederick M.** Recent Ostracoda from Scammon Lagoon, Baja California: Jour. Paleontology, v. 41, no. 2, p. 281–305, illus., 1967.

The Ostracoda of Scammon Lagoon are found in three recognizable assemblages: (1) inner lagoon, (2) lower lagoon, and (3) general lagoon, each of which has characteristic species and ecological associations. The fauna, exclusive of myodocopids, comprises 40 genera and 52 species, of which one genus and ten species are new. The new genus is *Anterocythere*, and the new species are *Bairdia phlegeri, Pumilocytheridea pseudoguardensis, Camplocythere hartmanni, Ambostracon hulingsi, Anterocythere purii, Paracytherois mexicana, Pellucistoma bensoni,*

Trachyleberidea henryhowei, Xestoleberis scammonensis, and *Cytherella vizcainoensis.*—Authors' abstract

McKnight, William R. *See* Berg, Joseph W., Jr. 10360

McMaster, Robert L. *See* Garrison, Louis E. 10482

10649 **McMullen, C. C.; Fritze, K.; Tomlinson, R. H.** The half-life of rubidium-87: Canadian Jour. Physics, v. 44, no. 12, p. 3033–3038, tables, 1966.

The quantity of Sr-87 produced from the decay of Rb-87 during an accurately known period of time has been determined. The analysis of the Rb-87 and the Sr-87 content of four different rubidium samples was performed by mass spectrometry. A value of $(4.72 \pm 0.04) \times 10^{10}$ years was calculated from the results of the measurements for the half-life of Rb-87.—Author's abstract

10443 **McNeal, B. L.; Norvell, W. A.; Coleman, N. T.** Effect of solution composition on the swelling of extracted soil clays: Soil Sci. Soc. America Proc., v. 30, no. 3, p. 313–317, illus., tables, 1966.

For soils containing expansible minerals, the swelling of extracted soil clays in mixed NaCl-$CaCl_2$ solutions, was well correlated with relative hydraulic conductivity of the soils to the same solutions, and with theoretical interlayer swelling values based on a "domain" model. In this model, mixed Na-Ca clays were considered to consist of discrete Na- and Ca-regions, with only the Na-regions swelling at low salt concentrations. The correlations suggested that the most plausible mechanism for hydraulic-conductivity decreases in soils containing significant amounts of expansible minerals is the closing of conducting pores by in situ mineral swelling. However, a dispersion process activated by the interlayer swelling of expansible minerals would also be compatible with the data.—Authors' abstract

Meade, Robert H. *See* Bond, Gerard C. 10621

10518 **Mehl, M. G.** The Domebo mammoth—Vertebrate paleomortology, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie Plains: Mus. Great Plains Contr., no. 1, p. 27–30, illus., 1966.

Preservation and dispersal pattern of remains of the Domebo mammoth, *Mammuthus imperator*, significance of missing skeletal elements, sediments surrounding the remains, and evidence of man-animal association were studied to determine cause of death. There is no evidence of human kill and butchering, such as hack marks or green bone fracture; the large bones could have been dragged by predators to their burial position. It is concluded that cause of death is unknown, although the two complete projectile points found close to the mammoth were possibly contributory to the death.—V.M.J.

10627 **Meinschein, W. G.; Nagy, Bartholomew; Hennessy, D. J.** Evidence in meteorites of former life—The organic compounds in carbonaceous chondrites are similar to those found in marine sediments, *in* Extraterrestrial life—An anthology and bibliography: Natl. Acad. Sci.-Natl. Research Council Pub. 1296A, p. 138–165, illus., tables, 1966; originally published 1963.

The history of research on meteoritic hydrocarbons and the controversy as to their significance are reviewed. Analyses of extracts of terrestrial sediments indicate that some may be used as biological indicators. Similarities between terrestrial and meteoritic extracts would constitute evidence that the meteorites were either contaminated or part of a parent body that supported life. Experimental procedure is described and results tabulated, with mass spectroscopy emphasized. Aromatic hydrocarbons are identified as common constituents of both meteoritic and terrestrial extracts. Data provide evidence against significant contamination. Many similarities of benzene extracts of carbonacous chondrites to extracts of terrestrial marine sediments are demonstrated and give evidence of biological activity in the parent body.—E.S.L.

00501 **Merritt, C. A.** Names and relative ages of granites and rhyolites in the Wichita Mountains, Oklahoma: Oklahoma Geology Notes, v. 27, no. 3, p. 45–53, illus., 1967.

At the present time ten names are in use for different members of the granite-rhyolite, probable Middle Cambrian, comagmatic series, of the Wichita Mts. Ham, Dennison, and Merritt broadened Carlton Rhyolite to a group name to include all rhyolites and associated pyroclastics. The term Wichita Granite Group was introduced to include the various granites, and it was concluded that the granite group was the intrusive equivalent of the extrusive rhyolite group. Combining mineralogic data, differentiation indices, and field relations, the relative ages of both granites and rhyolites are given. A geologic map of igneous rocks in the Wichita Mts. is included.—E.S.L.

Meyer, Gerald. *See* Davis, George H. 00505

10603 **Meyer, W. C.** (compiler). Cumulative list of theses on Canadian geography: Canada Dept. Energy, Mines and Resources Geog. Br. Bibliog. Ser. 34, 57 p., 1966.

This second edition of the above list includes theses and dissertations accepted to 1965; the first edition, published in 1964, included material to 1963. Citations are arranged according to province, with one section on methodology. Author and subject indexes are included.—M.C.M.

00504 **Meyers, W. C.** Palynological correlation of the Henryetta coal, Oklahoma: Oklahoma Geology Notes, v. 27, no. 2, p. 34–38, illus., 1967.

The Henryetta coal of the Pennsylvanian Senora Formation, Okmulgee County, is correlated with the Croweburg coal of northeastern Oklahoma on the basis of 35 species of palynomorphs common to both, similar percentages of the most abundant species, and similar succession.—E.S.L.

Meyrowitz, R. *See* Coleman, R. G. 10420

00345 **Miesch, A. T.** Theory of error in geochemical data: U.S. Geol. Survey Prof. Paper 574–A, p. A1–A17, illus., 1967.

All geochemical data collected for the purpose of describing the spatial variation of elements in a rock body contain errors due to both sampling and analysis. Some complex types of error that hinder interpretation of data, using either statistical or nonstatistical methods, are overall bias, variable bias, and variable precision. The effects are the same whether the error is due to sampling or analysis. Some types of error can be avoided by suitable precautions in the field or laboratory. The effects of other types may be overcome by data transformations.—A.T.M.

00459 **Miesch, A. T.** Methods of computation for estimating geochemical abundance: U.S. Geol. Survey Prof. Paper 574–B, p. B1–B15, illus., table, 1967.

The geochemical abundance of an element is the proportion of a total rock body that is made up of the element, and is equivalent to the population arithmetic mean of sample analyses, generally in parts per million or percent. Computational problems encountered in estimation of abundances can arise from having limited ranges of analytical sensitivity, from having only small groups of data, and from reporting data in broad geometric classes. These problems can be partly resolved using a combination of techniques, if analytical discrimination is sufficient to allow effective use of data transformations.—A.T.M.

10581 **Miller, David R.** Marine studies for the design and construction of offshore pipelines, Chap. 44 *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 991–1006, illus., 1966.

The design and construction of submarine pipelines involves special investigations and studies to understand marine environmental conditions which affect the location, installation methods, and design techniques for undersea lines. The paper will discuss application of marine geology, oceanography and marine engineering studies

to submarine pipeline problems. Types of submarine pipelines will be reviewed and special application problems of design and installation will also be reviewed.—Author's abstract

10410 **Miller, E. A.; Hall, E. B.** A comparison of soil shear strengths as determined with field and laboratory vane shear apparatus, *in* Vane shear and cone penetration resistance testing of in-situ soils—ASTM Pacific Area Natl. Mtg., 5th, Seattle, Wash., 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 399, p. 18–27, illus., table, 1966.

Even with the many limitations of the field vane shear apparatus, a defined degree of reliability has been attached to this method of determining the undrained shear strength of fine grain plastic soils. Test results obtained in San Francisco Bay muds by the field vane shear test are compared with those obtained by a laboratory vane device. Further comparisons are presented from the use of the "Q" type triaxial compression test on undisturbed specimens; remolded strengths were also determined. Close agreement was found to exist between the values obtained by both methods of vane testing as well as the triaxial tests. Definite variation was found in the shear strengths obtained by laboratory vane testing within a given 30-in.-long undisturbed, 3-in.-diameter piston sample.—G.D.C.

00317 **Miller, Raymond W.** Soluble silica in soil: Soil Sci. Soc. America Proc., v. 31, no. 1, p. 46–50, illus., table, 1967.

The concentration of soluble-silica in soil is determined by the soil's properties. If the soil layer has a low silica concentration value, large additions of silica from other sources (such as upper horizons) will not remain long in solution in simple forms. A conversion of "extra" soluble silica to disorganized forms adsorbed on various silicate mineral surfaces is suggested. Alteration of soluble silica to a lower concentration in soil solution is a relatively rapid process, and rapidly enough to alter concentrations as water moves through moist soil profiles. It is reasonable to assume that these characteristics are partly responsible for known deposits of silica and carbonates, variously known as silicate, duripan, caliche, and silica cemented hardpan. Increasing pH aids precipitation of carbonate; increased pH (from $CaCO_3$) may also reduce silica solubility in the solution.—*from* Author's conclusion

Miller, Robert A. *See* Wilson, Charles W., Jr. 10517

10583 **Miller, Robert A.** Mineral resources summary of the Bonnertown quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., 1966.

This text accompanies Tennessee Div. Geology Geol. Map GM 52-SE by R. H. Barnes and M. V. Marcher, 1966 (cited separately). Most of the Bonnertown quadrangle is underlain by cherty Mississippian rocks of the Fort Payne Formation and Warsaw Limestone. Chert from the Fort Payne is desirable for general uses and its maximum thickness is about 250 feet. The Warsaw, maximum thickness 35 feet, is blocky and therefore undesirable for road surfacing. Ten known chert pits in the quadrangle are inactive. Gravel pits are in Quaternary alluvial deposits which may be as thick as 20 feet. Although no limestone has been quarried, a number of formations (Fernvale, Leipers, Fort Payne) are present and constitute a limited source for local use.—M.C.M.

00471 **Miller, Robert D.** Geologic map of the Lexington West quadrangle, Fayette and Scott Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-600, scale 1:24,000, section, text, 1967.

Widely varying physical properties, lithologies, and thickness of bedrock and surficial materials have a direct bearing on urban and industrial expansion of the Lexington area. Bedrock consists of limestone and shale, some of which is unstable in vertical cuts. Unconsolidated surficial deposits vary in slope stability. Most exposed rocks provide satisfactory foundations for moderate to heavy loads where unaffected by solution of limestone; footings placed in part on poorly consolidated material and in part on bedrock may fail or settle unevenly. Sinks are common, soil is as much as 20 feet thick in some areas, and contact of bedrock and surficial

materials changes abruptly and ranges greatly in depth. Economic deposits most extensively exploited have been barite, limestone, and clay; only limestone and clay were being mined in 1963.—M.C.M.

Mills, J. W. *See* Rosenberg, P. E. 00406

10622 **Milton, Charles.** "Kansite" = mackinawite, FeS: Corrosion, v. 22, no. 7, p. 191–193, table, 1966.

"Kansite" is mackinawite, FeS. References to recent publications establishing this and correctly describing this important corrosion compound are given. Besides appearing as a corrosion product, it occurs naturally in tidal sediments, where hydrogen sulfide reacts with iron or iron compounds, and in most high temperature copper- and nickel ore deposits. It also has been synthesized in the laboratory. Mackinawite has been observed repeatedly for nearly a century, but until 1963 was generally confused with a similar-appearing but much rarer mineral, vallerite, $CuFeS_2$ and was described under that name.—Author's abstract

00420 **Moench, Robert H.; Schlee, John S.** Geology and uranium deposits of the Laguna district, New Mexico: U.S. Geol. Survey Prof. Paper 519, 117 p., illus., tables, geol. maps, 1967.

The Laguna district, an area of about 535 sq mi centering 50 mi west of Albuquerque, New Mex., forms the southeast end of the Southern San Juan Basin mineral belt—a west- to northwest-trending zone of uranium deposits associated with stratigraphic and tectonic Jurassic features. Within the district are the Jackpile and several other large uranium deposits all in the Jackpile sandstone of the uppermost Morrison Formation. Smaller deposits occur in the Todilto Formation in the lower Morrison. The Mesozoic and Cenozoic geologic history of the region are discussed in detail. Coffinite and uraninite, the chief ore minerals, are intimately mixed with carbonaceous matter which evidence suggests originated from decaying vegetable material. Uranium deposits probably formed in Jurassic time shortly after accumulation of host rocks. Paleogeography is the best guide to uranium.—V.S.N.

Moore, Gerald K. *See* Barnes, Robert H. 10604

10378 **Moore, T. C., Jr.; Heath, G. R.** Manganese nodules, topography and thickness of Quaternary sediments in the central Pacific: Nature, v. 212, no. 5066, p. 983–985, illus., table, 1966.

A correlation is found between thickness of Quaternary deposits, concentration of manganese nodules, and steepness of sea-floor slope in the central Pacific. Topographic features which trap downward-moving sediment would also tend to collect organic detritus and provide a favorable habitat for bottom-dwelling organisms. The combination of a suitable microtopography and an active benthos could explain the observed correlation.—D.B.V.

10592 **Morozova, I. P.** Novyye Permskiye mshanki Khabarovskogo kraya: Akad. Nauk SSSR Paleont. Zhur. 1966, no. 2, p. 33–41, illus., 1966; English translation, Internat. Geology Rev., v. 9, no. 2, p. 186–194, illus., 1966.

The new suborder Timanodictyoidea is established to accomodate two new families of Permian cryptostomatous Bryozoa: Timanodictyidae, which have bilamellar zoaria; and Girtyporidae, which includes dendroid and unilamellar forms in which the median plate is greatly reduced or lacking. New species from the Upper Permian of the USSR are described. Five species from the Guadalupian of Texas that Girty (1908) originally referred to *Domopora?*, as well as *D? ambigua* Reed from the Productus Limestone of the Salt Range, are considered to be species of *Girtypora*. Guadalupian *D? incrustans* Girty is placed in the new genus *Girtyporina*.—G.D.C.

00353 **Morris, D. A.; Johnson, A. I.** Summary of hydrologic and physical properties of rock and soil materials, as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey, 1948–60: U.S. Geol. Survey Water-Supply Paper 1839-D, p. D1–D42, illus., tables, 1967.

The Hydrologic Laboratory was established in 1948 to serve as the central testing laboratory for the Water Resources Division of the U.S. Geological Survey. Since then, thousands of samples of rock and soil materials have been analyzed in the laboratory. Analytical data on samples from 42 States and for the period 1948–60 are summarized in this report. The data are presented in a form that allows easy comparison of the physical and hydrologic properties of many sedimentary, igneous, and metamorphic rock and soil materials. Sedimentary rocks—the principal water-bearing rocks analyzed—are discussed in detail.—Authors' abstract

Morris, H. T. *See* Mabey, D. R. 00447

00489 **Morrison, Donald A.; Greenwood, William R.** Polymetamorphism and repetitive igneous activity in the Lochsa and Red River regions, Idaho County, Idaho [abs.]: Northwest Sci., v. 41, no. 1, p. 56, 1967.

10599 **Morrison, P. W.; Hofmann, R. B.; Wolfe, J. E.** Parkfield earthquakes, June 28–29, 1966: Earthquake Notes, v. 37, no. 3, p. 5–18, illus., 1966.

The Parkfield [California] earthquake produced an instrumentally recorded acceleration of 0.5g but caused little structural damage because of the short duration of the maxima. Remeasurements of geodetic lines established in the area six months prior to the earthquake indicate approximately seven inches of right-lateral movement along the San Andreas fault.—Authors' abstract

Mound, Michael C. *See* Longwell, Chester R. 00439

Mudgett, Philip M. *See* Cook, Kenneth L. 10481

00543 **Mueller, Robert F.** High temperature and pressure aqueous solubility data bearing on the stability of silicates: Jour. Geology, v. 75, no. 1, p. 121–126, illus., 1967.

Equilibrium constants for the aqueous reactions: $2MgSiO_3$ (orthopyroxene) $+2H_2O=Mg_2SiO_4+Si(OH)_4$, and SiO_2 (quartz) $+2H_2O=Si(OH)_4$ are compared, simplifying assumptions made, and the relationship $K_2={}^{X}Si(OH)_4/{}^{X}Si(OH)_4$ arrived at, where K_2 is the constant for the reaction: $2MgSiO_3=Mg_2SiO_4+SiO_2$, ${}^{X}Si(OH)_4$ is the mole fraction of silica dissolved from orthopyroxene in steam at 873°K and 1,000 bars, and ${}^{X}Si(OH)_4$ is the mole fraction of silica dissolved from quartz in steam at similar T and P. The Gibbs free energy of reaction, calculated from K_2, is +2,890 cal. Aqueous reactions involving talc and anthophyllite also are considered.—F.B.

10491 **Mueller, Robert F.** Stability relations of the pyroxenes and olivine in certain high grade metamorphic rocks: Jour. Petrology, v. 7, no. 3, p. 363–374, illus., tables, 1966.

Stability relations of mineral assemblages in various combinations constituting amphibolite and granulite facies rocks are analyzed with emphasis on the reactions: (1) $MgSiO_3+CaCO_3+SiO_2=CaMgSi_2O_6+CO_2$ and (2) $MgSiO_3+CACO_3=Mg_2SiO_4+CaMgSi_2O_6+CO_2$, and associated reactions involving ferrous iron. In (1) orthopyroxene composition is a linear function of the CO_2 fugacity. Reaction (2) is displaced strongly to the right under most metamorphic conditions. Use of pyroxene-bearing assemblages as indicators of metamorphic grade is questionable.—G.D.C.

Müller, K. J. *See* Rhodes, F. H. T. 10471

Mulvihill, Michael E. *See* Palmer, Robert Q. 10595

Munizaga, F. *See* Hart, S. R. 00614

10390 **Munjal, P.; Fatt, I.** Thermal anisotropy in rocks: Nature, v. 212, no. 5069, p. 1418–1420, illus., 1966.

A method of detecting thermal anisotropy is described, which may be of use in locating bedding planes in sedimentary rocks or foliation planes in igneous or metamorphic rocks when such features are invisible or ambiguous. The method can also be used to ascertain the orientation of the thermal anisotropy ellipsoid with respect to the direction cosines of the block surfaces from a single measurement on a single block of rock.—D.B.V.

10371 **Murata, K. J.; Richter, D. H.** The settling of olivine in Kilauean magma as shown by lavas of the 1959 eruption: Am. Jour. Sci., v. 264, no. 3, p. 194–203, 1966.

Compositions of lavas of the 1959 Kilauea eruption in Kilauea Iki crater characterize the first stage of fractional crystallization of tholeiitic magma with unusual precision and completeness. Gravitative settling of olivine ($Fa_{12.5}$) produces a series of lava types ranging from picrite-basalt to olivine-poor basalt. Variation of lava temperature with olivine content suggests zoning of the subterranean magma body into a cooler, olivine-depleted upper part and a hotter, olivine-enriched lower part. The most picritic lavas were erupted during periods of high rates of lava discharge; unusually strong magma currents may have mobilized the sludge of sedimented olivines at the bottom of the magma chamber to produce picritic magma.—E.W.W.

Murphy, H. D. *See* Herbich, John B. 10580

Murthy, V. Rama. *See* Stueber, Alan M. 10366

10553 **Musgrove, Rufus H.; Barraclough, Jack T.; Grantham, Rodney G.** Water resources records of Escambia and Santa Rosa Counties, Florida: Florida Geol. Survey Inf. Circ. 50, 106 p., illus., tables, 1966.

Escambia and Santa Rosa Counties, westernmost in Florida, have an abundant supply of both ground and surface water of excellent quality. A four-year study was begun in 1958 to determine the effect of municipal and industrial expansion on the resources without creating problems of water shortages, salt-water encroachment, and pollution. The interpretive results and selected data are contained in Florida Geol. Survey Rept. Inv. 40, 1965, by the same authors. This report includes records of streamflow, chemical analyses, temperature, and specific conductance records of surface water, chemical analyses of ground water, well descriptions and records of ground-water levels.—M.C.M.

Mutschler, Felix E. *See* Gaskill, David L. 00607

10375 **Myer, George H.** New data on zoisite and epidote: Am. Jour. Sci., v. 264, no. 5, p. 364–385, illus., tables, 1966.

Zoisite (β-zoisite) is iron-poor, and ferrian zoisite (α-zoisite) is iron-rich. With increasing ferric iron content the optic angle $2V_z$ appears to vary from about 60° through 0° to 70° with concomitant change of optic plane orientation from (010) to (100). Study of 20 epidotes from greenschist, blueschist, and almandine amphibolite facies rocks has shown that they are similar in major-element composition to hydrothermal epidote. Their X-ray unit cell parameters are in substantial agreement with regressions based on hydrothermal epidote, and the (020) X-ray determinative curve appears applicable to epidote from a wide range of geologic environments. Mineral assemblages containing both epidote and ferrian zoisite appear limited to layered calc-silicate rocks in the middle almandine amphibolite facies. These minerals do not overlap in composition and probably represent equilibrium assemblages in these rocks.

00451 **Myers, Donald A.** Geologic map of the Torreon quadrangle, Torrance County, New Mexico: U.S. Geol. Survey Geol. Quad. Map GQ-639, scale 1:24,000, 1967.

10591 **Nace, Raymond L.** Hydrology at the crossroads, *in* Symposium on hydrology and water resources development, Ankara, Turkey, 1966: Ankara, Turkey, Central Treaty Organization, p. 19–28, 1966.

The history of water use and management from ancient times to the present is summarized in this paper. Engineering hydrology first developed in arid lands with the change to irrigation agriculture. Hydrology was not a generally recognized scientific discipline in the United States until about 1960, although the American Geophysical Union recognized it more than 30 years ago. In Europe and many other areas where it has been so recognized, *hydrology* commonly means *surface-water hydrology*. It is suggested that hydrology needs a classical period of unification in order to understand the occurrence, behavior, and significance of water in the total physical and biological system of the Earth; intelligent subdivision can develop later.—M.C.M.

Nagy, Bartholomew. *See* Meinschein, W. G. 10627

Nagy, Bartholomew S. *See* Faust, George T. 00356

10606 **Nair, P. K. K.** Essentials of palynology: New York, Asia Publishing House, 96 p., illus., tables, 1966.

The six chapters of the book are: aspects and prospects of palynology—general background; pollen and spore morphology—detailed account of structure of pollen grains and spores and the significance of their morphology; aeropalynology—an account of the principles, techniques, and atmospheric types; melittopalynology.—technique of pollen collection by honey bees; fossil palynology—source of the origin of the science and a major part of the literature; and select bibliography. A glossary of terms and an index to plant names are appended.—E.S.L.

10488 **Naldrett, A. J.** Talc-carbonate alteration of some serpentinized ultramafic rocks south of Timmins, Ontario: Jour. Petrology, v. 7, no. 3, p. 489–499, illus., tables, 1966.

Serpentinized peridotites in an area south of Timmins, Ontario, have been extensively altered to talc and carbonate. In some places, rocks altered in this way have subsequently been decarbonatized and converted back to a serpentine-magnetite assemblage. Chemical analyses of variably altered rocks indicate that the bulk chemical changes involved in the talc-carbonate alteration have been the addition of CO_2 and removal of H_2O and a very small amount of O_2. Little or no magnesium, silicon, iron, or nickel metasomatism has occurred. Consequently the relative partial pressures of H_2O and CO_2 in solutions passing through the rocks are likely to have been controlling factors for the alteration and subsequent decarbonatization.—Author's abstract

00398 **Nasmith, H.; Mathews, W. H.; Rouse, G. E.** Bridge River ash and some other Recent ash beds in British Columbia: Canadian Jour. Earth Sci., v. 4, no. 1, p. 163–170, illus., tables, 1967.

The Bridge River ash from postglacial sites in British Columbia and Alberta consists of dust-size shards with ellipsoid fragments of pumice. It both thins and fans out, from a source around the upper Lillooet River, east-northeasterly to westernmost Alberta near the North Saskatchewan River. Radiocarbon dating of underlying peat in a bog near Jesmond, B. C., gives the ash an age of 2440±140 yr B.P. The track of the Bridge River ash overlaps that of the Mazama ash, about 6,600 yr old, but lies north of the presently known distribution of St. Helens Y ash, about 3,200 yr old. With a distinctive character and limited distribution, the Bridge River ash may be valuable as a postglacial marker horizon in southcentral British Columbia.—G.D.C.

Nason, Robert D. *See* Curray, Joseph R. 00440

00522 **Nassichuk, W. W.** A morphologic character new to ammonoids portrayed by *Clistoceras* gen. nov. from the Pennsylvanian of Arctic Canada: Jour. Paleontology, v. 41, no. 1, p. 237–242, illus., table, 1967.

Clistoceras globosum, n.gen., n.sp., an ammonoid [goniatite] from Pennsylvanian (Atokan) strata of northwestern Ellesmere Island in the Canadian Arctic is described and illustrated. This taxon bears unique primary deposits that formed on the venter

of the penultimate volution, in front of the aperture and during adolescence tended to close the umbilicus. To describe these deposits the term *helicolateral* is coined. The position of a distinct *runzelschicht* layer suggests a homologous relationship between that layer and the conspicuous black film that is secreted in the vicinity of the aperture of living *Nautilus*.—Author's abstract

10566 **Nelner, S. H.** Logistics and problems of Arctic and sub-Arctic logging, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. Y1–Y7, illus., 1966.

The area considered is that part of the Western Canada Sedimentary basin lying north of the 60th parallel. Because of the transporation problems and cost, most logging programs have been limited to resistivity, acoustic velocity, and gamma neutron. If transportation permits, density, contact-caliper, dipmeter, and possibly sidewall core would be added.—E.S.L.

00352 **Nelson, Arthur E.** Geologic map of the Corozal quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-473, scale 1:20,000, sections, text, 1967.

The Corozal quadrangle is on the north flank of the Puerto Rico anticlinorium, and rock units occur in westerly striking bands parallel to its axis. Several grabens are associated with easterly trending faults, joints are well developed, and shearing along faults has produced a cleavage in some rocks. Several folds in the quadrangle are shown on the cross sections. Bedrock suitable for aggregate and fill material is available at many places, an almost unlimited amount of slightly ferruginous limestone can be obtained from the Lares Limestone and the lower part of the Cibao Formations, and some deposits of sand and gravel occur in the river valleys. Other resources include clay, small amounts of gold, manganese, and traces of copper.—M.C.M.

Nelson, Carl W. *See* Gordon, Robert B. 10343

00338 **Newcome, Roy, Jr.** Development of ground water supplies at Mississippi Test Facility, Hancock County, Mississippi: U.S. Geol. Survey Water-Supply Paper 1839-H, p. H1-H28, illus., tables, 1967.

Potable and industrial water supplies at the NASA Mississippi Test Facility in Hancock County, Miss., are obtained from large capacity wells that tap southward-dipping water-bearing Miocene and Pliocene sands. The fresh water-bearing section is 2,000-3,000 feet thick; individual aquifers are as thick as 450 feet, 100 feet being the average. Three wells installed for potable water supply are 1,434-1,524 feet deep and have produced 1,100-2,500 gpm by natural flow. Water for cooling Saturn rocket test stand deflectors is obtained from three wells 1,873, 1,695, and 672 feet deep; production rates are 3,100, 4,500, and 5,000 gpm, respectively, and they are capable of supplying 18 mgd. Water from the supply wells is soft and of good quality.—*from* Author's abstract

10372 **Newton, Robert C.** Some calc-silicate equilibrium relations: Am. Jour. Sci., v. 264, no. 3, p. 204-222, 1966.

P-T curves determined experimentally for univariant equilibria are: (1) zoisite + quartz = anorthite + grossularite + vapor; (2) grossularite + quartz = anorthite + wollastonite; (3) zoisite + sillimanite = quartz + anorthite + vapor. Thermodynamic constants calculated from the results and published data give P-T curves for other reactions in the system CaO-SiO_2-Al_2O_3-H_2O, entropy of grossularite and zoisite, and ΔG for sillimanite. Reactions 1 and 2 agree with natural assemblages. The calculated anorthite breakdown curve lies at a lower pressure but close to the curve of albite (Birch and Le Conte, 1960) indicating that intermediate plagioclase may break down as a unit during a subcrustal phase change.—R.W.T.

Nicholls, Harry. *See* Winston, Don. 00559

Nichols, Haven. *See* Perry, Richard B. 10531

10413 **Nir, A.; Kruger, S. T.; Lingenfelter, R. E.; Flamm, E. J.** Natural tritium: Rev. Geophysics, v. 4, no. 4, p. 441–456, illus., tables, 1966.

Tritium investigation is reviewed from 1932 to present. Recalculation of cosmic-ray production rate yields an average of $0.20 \pm .09$ triton/cm^{2}sec during solar minimum and $0.16 \pm .09$ triton/cm^{2}sec during solar maximum. Production by interaction of solar flare accelerated particles with the atmosphere is less than 3 percent of that by galactic cosmic rays. Calculations of tritium decay rate from material balance, utilizing measured concentrations of rain and ocean water corrected for synthetic tritium, are consistent within limits of error with production rate by galactic cosmic rays. Best estimate of prebomb inventory is a decay rate of $0.5 \pm .3$ triton/cm^{2}sec as compared with estimated production rate of $0.19 \pm .09$ triton/cm^{2}sec. In view of the large errors it is not possible to determine whether appreciable amounts of tritium are accreted from the Sun.—*from* Authors' abstract

00388 **Nishita, H.7 Essington, E. H.** Effect of chelating agents on the movement of fission products in soils: Soil Science, v. 103, no. 3, p. 168–176, illus., 1967.

Chelating agents (EDTA, DTPA, and EDDHA) and deionized water were evaluated as to their ability to move several radioactive fission products (Sr-89, Y-91, Ru-106, Cs-137, and Ce-144) in different kinds of soils. Irrespective of the kind of soil, the order of magnitude of movement by water leaching was Cs-137, Y-91, Ce-144<Sr-89<<Ru-106. EDDHA was generally least effective, while the relative effectiveness of DTPA and EDTA varied with the soil and radioactive material.—J.W.H.

00490 **Nord, Gordon L., Jr.** Repetitive imbricate thrust faulting in the Illinois Peak area, Shoshone County, Idaho [abs.]: Northwest Sci., v. 41, no. 1, p. 56–57, 1967.

00372 **Norris, Robert M.** Robert Barton Guillou (1923–1965): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 434, portrait, 1967.

Norton, L. J. *See* Baldwin, W. F. 10548

Norvell, W. A. *See* McNeal, B. L. 10443

Nota, D. J. G. *See* Loring, D. H. 10594

O'Bryan, Deric. *See* Crooks, James W. 00453

Odell, R. T. *See* Liu, T. K. 10399

Oeschger, H. *See* Wasson, John T. 00357

00539 **Olive, Wilds W.** Geologic map of part of the Cayce quadrangle, Hickman and Fulton Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-601, scale 1:24,000, text, 1967.

The Cayce quadrangle is almost completely covered by a blanket of loess and stream alluvium; to determine thickness and composition of this cover and what lies beneath, a series of auger holes was drilled across the quadrangle. Lithologies determined from auger samples are shown in columns on the map sheet. Clay of the Coastal Plain deposits may be suitable for use in the manufacture of some types of ceramic products. Twenty five feet of light grayish-brown clay was penetrated in drill hole 44 without reaching the base of the body.—M.C.M.

Oliver, John G. *See* Kidby, Harold A. 10577

Omodt, H. W. *See* Redmond, C. E. 00319

Osborn, E. F. *See* Roeder, P. L. 10460

Osmer, Judith A. *See* Chase, A. B. 10422

Osterberg, Charles. *See* Johnson, Vernon. 00325

00563 **Ostroff, A. G.** Comparison of some formation water classification systems: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 404–416, illus., tables, 1967.

Waters from various geological formations are classified by the systems of Palmer, Sulin, and Schoeller. "According to Sulin's system, waters known to be in contact with petroleum are of the following types: chloride–calcium > bicarbonate–sodium > chloride–magnesium > > > sulfate–sodium. In Schoeller's system, positive indications of base exchange are calculated for Sulin's chloride–calcium and chloride–magnesium types with negative indications for bicarbonate–sodium and sulfate–sodium types."—W.C.C.

Overstreet, Roy. *See* Carlson, R. M. 00389

00545 **Paaswell, Robert E.** Thermal influence on flow from a compressible porous medium: Water Resources Research, v. 3, no. 1, p. 271–278, illus., 1967.

Transient flow through a porous medium is dependent upon both the permeability and compressibility of the matrix, two highly temperature dependent properties. The analysis of a consolidating mass subject to constant temperature levels is extended to predict transient flow behavior for conditions of boundary temperature increases on a stress-saturated clay after pore pressure dissipation. Magnitudes of immediate volume changes were primarily dependent upon magnitude of the temperature change, and secondarily upon magnitude of the initial stress. These volume changes are attributed to a transfer of stress between pore fluid and matrix, as the increases in temperature increase the pore pressure but decrease the matrix strength.—G.D.C.

10595 **Palmer, Robert Q.; Mulvihill, Michael E.; Funasaki, Gerald T.** Hilo harbor tsunami model—Reflected waves superimposed, *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 21–31, illus., 1966.

Hydraulic model studies have been conducted to analyze the catastrophic damage in Hilo Harbor, Hawaii, resulting from tsunamis. Results of these investigations and also information in various publications based on observations of damage, indicate that damage at Hilo is caused by a combination of three bathymetric conditions: the submarine ridge formations outside the bay mouth refract the wave into the bay, the triangular configuration of the bay has a compressive effect on the wave, and the wave reflected off the cliffs bordering the Hamakua coast superimposes on top of the incident wave in the Hilo harbor.—V.S.N.

Parham, Walter E. *See* White, W. Arthur. 00520

00375 **Parker, Everett C.** Robert Barnes McNeely (1902–1966): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 437–438, portrait, 1967.

10655 **Parker, Everett C.** The Pennsylvanian rocks north of Ardmore, *in* Pennsylvanian of the Ardmore Basin, southern Oklahoma—Ardmore Geol. Soc., Field Conf. 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., p. 29–37, illus., 1966.

A complete section of the Morrow, Des Moines, and Missouri rocks is present in the synclines; members of the Dornick Hills and Deese Groups, as well as the Chester Series, are described. The name Morris Ranch Member is proposed for a massive sandstone in the Deese Group above the brachiopod limestone. Several sections are included.—E.S.L.

10500 **Parker, Garald G.** Relationships between salt-water and fresh-water, *in* Am. Water Resources Conf., 2d Ann., Chicago, 1966, Proc.: Am. Water Resources Assoc. Proc. Ser., no. 2, p. 32–37, 1966.

In the understanding of their relationships lies the key to successful development, use, conservation and control of water supplies, not only in coastal and desert areas.

but also where there are shallow saline deposits, where oil-field brines or industrial waste bitterns must be disposed of, and in irrigated drylands. Encroachment in coastal aquifers is the most widespread, serious, and costly problem; some of the published information of the past 20 years is noted. This symposium includes four papers, three of which by Upson, Foley, Latta, and Hem are separately cited. The other by A. T. Ippen deals with interacting currents in estuaries and tidal canals, and the consequences of man's interference.—G.D.C.

Parker, J. William. *See* Baars, D. L. 00369

10624 **Parker, Ronald B.** The "Cheapskate" point-counter for large specimens: Wyoming Univ. Contr. Geology, v. 5, no. 2, p. 44–45, illus., 1966.

A description is given for constructing a point-counter for modal analysis of rocks using pressed board, threaded rod, pillow blocks, a clockspring, casters, nuts, and washers. The instrument proved practical and simple to use.—M.C.M.

00544 **Pearson, F. J., Jr.; White, D. E.** Carbon 14 ages and flow rates of water in Carrizo Sand, Atascosa County, Texas: Water Resources Research, v. 3, no. 1, p. 251–261, illus., table, 1967.

Carbon-14 carbonate dissolved in ground water is derived from plant-produced CO_2 in the soil of the recharge area and is usually diluted by carbon-14-free carbonate dissolved from minerals in the soil and in the aquifer. Techniques based on ratios of stable isotopes and overall carbonate chemistry of the water can be used to correct for this dilution and allow calculation of true water ages. In Texas, ages of water samples dated by this method from wells of the Eocene Carrizo Sand ranged from 0 at the outcrop to 27,000 years downdip 35 miles. Based on C-14 ages, water velocities were about 8 feet per year 10 miles from the outcrop and 5.3 feet per year at 31 miles. Flow rates calculated from available hydrologic data are in agreement with these results.—G.D.C.

10356 **Pearson, John E.; Jones, Gary E.** Soil concentrations of "emanating radium-226" and the emanation of radon-222 from soils and plants: Tellus, v. 18, no. 2–3, p. 655–662, illus., tables, 1966.

Values of radon-222 emanation from soils and concomitant variation of factors affecting the rate of emanation are reported. Measured values of radium-226 in the soil capable of giving rise to diffusing radon varied 70-fold in different geological regions, but were uniform in Champaign County, Ill., where the content was $(0.64 \pm 0.09) \times 10^{-12}$ grams of "emanating Ra-226" per gram of soil. The emanation rate of radon-222 from soils into the atmosphere varied 1,000-fold among geographic regions but was also uniform in Champaign County, averaging $(140 \pm 73) \times 10^{-18}$ curies per sq cm per sec. Thus Rn-222 may be used as a cost-free tracer in vertical diffusivity studies in Champaign County.—D.B.V.

00472 **Peckham, Richard C.** The role of ground water in the Texas Water Plan, *in* Additional technical papers on selected aspects of the preliminary Texas Water Plan: Texas Water Devel. Board Rept. 38, p. 3–23, illus., table, 1967.

The Texas Water Plan includes the entire State in its examination of water availability and requirements projected into the next century; proposes the means to implement the plan's components; and for the first time, gives extensive attention to ground water. Although ground water is excluded by law from state management, it must be depended upon to meet a part of future water requirements, and is expected to furnish 2.3 million acre-ft of municipal and industrial requirements by the year 2020 as compared to 1.5 million acre-ft in 1960. Most ground water occurs in the eastern part of the State. Major aquifers are the Ogallala, alluvium, Edwards-Trinity (Plateau), Edwards (Balcones Fault Zone), Trinity Group, and the Carrizo-Wilcox and Gulf Coast.—M.C.M.

Peddicord, R. G. *See* Valentine, J. W. 00610

10531 **Perry, Richard B.; Nichols, Haven.** Submarine geology of the Aleutian arc, Alaska [abs.]. *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 75, 1966.

Petch, H. E. *See* Hainsworth, F. N. 10644

10503 **Peter, G.; Elvers, D.; Dewald O.** Results from a geophysical survey of the northeast Pacific Ocean [abs.]. *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 70, 1966.

10363 **Petersen, G. W.; Corey, R. B.** A modified Chang and Jackson procedure for routine fractionation of inorganic soil phosphates: Soil Sci. Soc. America Proc., v. 30, no. 5, p. 563–565, illus., 1966.

Use of constant suction pipettes, two molybdophosphoric reductants with different sensitivities, and an isobutyl alcohol extraction for the determination of reductant soluble phosphates greatly increased the speed of the phosphorous determinations. Results from 100 duplicated profile samples of the great soils of Wisconsin had average coefficients of variation and correlation between duplicates within samples for the four phosphate fractions of 3.7 percent and 0.998, respectively.—G.D.C.

10376 **Peterson, M. N. A.; Borch, C. C. von der; Bien, G. S.** Growth of dolomite crystals: Am. Jour. Sci., v. 264, no. 4, p. 257–272, illus., table, 1966.

Surfaces of growing crystals of dolomite from Deep Springs Lake, Calif., are Ca-rich. The surfaces of the crystals have a Ca to Mg ratio in excess of 4: the surface layer is about 100A thick and approaches the composition of dolomite at its inner side. Successive fractions have been dated by C-14 and thus place a time parameter on the introduction of magnesium into the rhombohedral carbonate lattice. The crystals grow by the production of a transient surface layer which can be envisaged as a moving boundary through which the magnesium must move by solid-state diffusion with concomitant migration of calcium in the opposite direction. The formation of dolomite having a rudimentary R_3 space group takes place at the inner side of the surface layer. Crystal growth models are considered, along with implications concerning rates of growth and diffusion, solubility, and isotopic fractionation.—*from* Authors' abstract

10499 **Pfannkuch, Hans-Olaf.** The application of geophysics to water resources, *in* Am. Water Resources Conf., 2d Ann., Chicago, 1966, Proc.: Am. Water Resources Assoc. Proc. Ser., no. 2, p. 287–297, illus., table, 1966.

This paper deals with a review and discussion of well logging practices. Interpretation of the logs for subsurface geology, reservoir and well hydrology, and fluid quality, has to take into account certain corrective factors to obtain good vertical resolution. Electrical resistivity and acoustical measurements are discussed as examples. For the complete analysis of an aquifer, its porosity and total storage capacity need to be defined by logging methods. Useful empirical relations are needed for ground-water conditions where those from oil-field practice are not applicable. More theoretical investigations on a microscopic scale are needed to get a better idea of permeability, and its relations to transport processes.—G.D.C.

00546 **Picard, M. Dane.** Paleocurrents and shoreline orientations in Green River Formation (Eocene), Raven Ridge and Red Wash areas, northeastern Uinta basin, Utah: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 383–392, illus., 1967.

Data from ripple marks and cross stratification in the Green River Formation indicate the dominant paleocurrent directions are toward the north, south, and southeast. Vertical stratigraphic variation of paleocurrent directions is small. The shorelines in the northeastern Uinta basin area are interpreted to have been generally at right angles to the dominant paleocurrent directions. The shorelines had bearings of 31° to 120°, and an arc of 61° to 90° would contain about 40 percent of the bearings.—W.L.A.

Picciotto, E. *See* Crozaz, G. 10416

00441 **Pilkey, Orrin H.; Luternauer, John L.** A North Carolina shelf phosphate deposit of possible commercial interest: Southeastern Geology, v. 8, no. 1, p. 33–51, illus., tables, 1967.

An elongate, surficial deposit of phosphatic sand lies east of Frying Pan Shoals off Cape Fear, N. C. The area of highest phosphate concentration is about 10 miles long and 4 miles wide, in water depths of 20 to 30 m. The richest sample contained 40 percent phosphorite grains and 7.78 percent P_2O_5. These values in surficial material may have been decreased by dilution with quartz and shell material and increased by winnowing of non-phosphatic fines. Rocks dredged from bottom outcrops are friable, weathering, slightly phosphatic limestones, from which it is concluded the sand is derived. Thickness of the deposit will depend on subbottom topography and the length of time during which weathering of the limestone has occurred. Further prospecting is warranted, and procedures suggested.—G.D.C.

00422 **Pirson, S. J.** How to use well logs to seek hydrodynamically trapped oil: World Oil, v. 164, no. 5, p. 100–106, illus., 1967.

Well log interpretation techniques for finding hydrodynamically entrapped gas and oil are now possible because of fine vertical resolution of new logging tools, together with a better understanding of fluid saturation distribution in reservoir rocks. Techniques of this new approach to finding gas and oil accumulations are described.—*from* Author's abstract

00423 **Pirson, S. J.** How to map fracture development from well logs: World Oil, v. 164, no. 4, p. 106, 108, 113–114, illus., 1967.

Fracture mapping parameters have been derived from conventional electric well logs, and techniques have been developed to lessen the ambiguity of numerous surface fractures observed in photogeology by combining photogeologic data with fracture intensity studies from well logs. Five described indices derivable from conventional electric logs may be used in exploration for fractured reservoirs associated with major faulting and when the appropriate fracturing indices may be measured on a brittle bed close to the potential reservoir.—Author's abstract

10402 **Pirson, S. J.** Oil finding by systematic well log analysis: Log Analyst, v. 6, no. 5, p. 4–17, illus., table, 1966.

Eight attributes have been established as necessary and sufficient to warrant the discovery of a commercial oil and gas field. While some of these attributes may be ascertained by methods of exploration that are purely geological and/or geophysical, this paper is solely concerned with the derivation of these attributes from well logs of all sorts. Well logs may be considered as the result of geophysical exploration in bore holes. Much more information may be derived from them than is generally provided by conventional well log analysis; in fact, more than 50 well-log derived mapping parameters have been conceived and more than 30 have been evaluated. As many as 17 different and independent mapping parameters have been used on a single prospect. When such maps confirm each other it is tantamount to having mapped a single significant parameter measured on many more wells than actually drilled.—Author's abstract

10564 **Pirson, S. J.; Alparone, N.; Avadisian, A.** Implications of log derived radioactivity anomalies associated with oil and gas fields, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. V1–V25, tables, 1966.

Geological implications of radioactivity anomalies in relation to petroleum origin and the genesis of mineralization anomalies in radioactive elements are discussed. Anomalies have been mapped from well logs at various stratigraphic levels from more than two dozen known fields; 19 are tabulated and radioactivity maps from Westerose, Alberta, and Wellman, Texas, included; five fields predicted by this method are tabulated. The presence of a radioactive chimney over oil and gas fields resulting from primary migration and accumulation appears well established and

this phenomenon can be used as an exploration tool provided a sufficient number of wells has been drilled and radiation logged to a sufficient depth and according to standardized procedures.—E.S.L.

00452 **Plafker, George.** Geologic map of the Gulf of Alaska Tertiary province, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-484, scale 1:500,000, 1967.

The map sheet includes inset maps showing location of area, district subdivisions and sources of data used in compiling the geologic map, and major physiographic features; reference lists; and tables of wells showing subsurface stratigraphy.—M.C.M.

10467 **Platt, Lucian B.** Orogeny and geochronology [discussion of paper by James Gilluly, 1966]: Am. Jour. Sci., v. 264, no. 9, p. 745–750, 1966.

Gilluly (ibid., no. 2, p. 97–111) uses orogeny and pluton so that they include more than the author would have wished to include, and Gilluly has chosen narrow geographic limits in showing a lack of correlation between plutonism and orogeny. The author still believes that where evidence can be obtained, there is an association between plutons and orogeny.

10425 **Pollack, Sidney S.** Disordered orthopyroxene in meteorites: Am. Mineralogist, v. 51, nos. 11–12, p. 1722–1726, tables, 1966.

Disordered orthorhombic pyroxene, which was first found in meteorites by Brown and Smith (1963), and later by Pollack and Ruble (1964), has now been found in all the enstatite achondrites except Shallowater. It has also been found in the Stannern (eucrite), Abee (enstatite chondrite) and Hugoton (olivine-bronzite chondrite).—Author's abstract

00367 **Potter, Paul Edwin.** Sand bodies and sedimentary environments—A review: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 337–365, illus., tables, 1967.

Sand-body morphology, based upon knowledge of depositional environment, may help to solve exploration problems. In interpreting these environments, shape, horizontal dimensions, and orientation are important, and in sedimentation studies, transverse and longitudinal stratigraphic cross sections are informative. A sedimentary environment is defined by a set of values of physical and chemical variables that correspond to a geomorphic unit of stated size and shape. Sand-body characteristics of alluvial, tidal, turbidite, barrier island, shallow-water marine, and desert eolian environments are described in terms of petrology, texture, sedimentary structures, fossils and lithologic features, internal organization, and external morphology. Predicting location and areal extent of new bodies requires knowledge of: depositional environment, regional distribution of facies combined with paleoslope determination and prior experience with similar bodies.—E.A.M.

10468 **Presnall, D. C.** The join forsterite-diopside-iron oxide and its bearing on the crystallization of basaltic and ultramafic magmas: Am. Jour. Sci., v. 264, no. 10, p. 753–809, illus., tables, 1966.

At oxygen fugacities from $10^{-0.68}$ to $^{-6}$ atm minimum liquidus temperature on the above join remains nearly constant in temperature and composition at 1300°C and 79 percent diopside, 21 percent iron oxide. Comparison with other data indicates: Skaergaard intrusion is a result of a close approach to fractional crystallization of an anhydrous magma at constant total composition; if similar basaltic magmas have crystallized at relatively low pressures and derived liquids have been produced at the surface as lavas, oxygen fugacities were controlled by oxidizing buffers; reaction rims of hypersthene and magnetite on olivine phenocrysts result from partial resorption of olivine; at low pressures peridotites exist while partly liquid at temperatures as low as 1250°C, and fractional crystallization of ultramafic magma with buffered oxygen fugacity explains origin of the Duke Island, Alaska, ultramafic complex.—*from* Author's abstract

10430 **Press, Frank; Harkrider, David.** Air–sea waves from the explosion of Krakatoa: Science, v. 154, no. 3754, p. 1325–1327, illus., 1966.

The distant sea disturbances which followed the explosion of Krakatoa are correlated with recently discovered atmospheric acoustic and gravity modes having the same phase velocity as long waves on the ocean. The atmospheric waves jumped over the land barriers and reexcited the sea waves with amplitudes exceeding the hydrostatic values. An explosion of 100 to 150 megatons would be required to duplicate the Krakatoa atmospheric-pressure pulse.—Authors' abstract

00393 **Price, R. A.** The tectonic significance of mesoscopic subfabrics in the southern Rocky Mountains of Alberta and British Columbia: Canadian Jour. Earth Sci., v. 4, no. 1, p. 39–70, illus., 1967.

Brittle failure in anisotropic layered non-metamorphic rocks characterizes deformation in the southern Rocky Mountains of Canada. Megascopic structure is dominated by interlocking imbricate thrust plates that have moved eastward and upward. Mesoscopic subfabrics are fractures parallel or perpendicular to bedding, or intersecting it at 25° or 70° angles. As discrete slickensided surfaces of slip, as zones of dilation filled with vein minerals, or as surfaces of pressure solution now marked by stylolites, these fractures record the kinematic history of deformation. Within a broad area near Crowsnest Pass, two different movements are in superposition, where two regional structural salients converge. Transverse faults in parts of the Front Range are probably older gravity faults controlled by fabric of the Hudsonian basement.—G.D.C.

Pritchard, J. I. *See* Keller, G. V. 10393

00514 **Proctor, Cleo V., Jr.** (compiler). Paperback books for earth science teachers: Jour. Geol. Education, v. 15, no. 1, p. 29–55, 1967.

This is the first of a series of annotated bibliographies of interest to earth science teachers. More than 600 books are cited under 10 categories, some under more than one if appropriate. It is hoped that through use of a wide and varied selection of inexpensive and interesting books, the pupil may become the student.—E.S.L.

10439 **Prostka, Harold J.** Igneous geology of the Dry Mountain quadrangle, Jefferson County, Montana: U.S. Geol. Survey Bull. 1221-F, p. F1–F21, illus., geol. map, 1966.

Oldest rocks in the Dry Mountain quadrangle are the Late Cretaceous Elkhorn Mountains Volcanics consisting mainly of tuff, agglomerate, lava flows, and volcanic breccia, overlain by several sheets of welded tuff; about 5,700 feet of these rocks is exposed. The volcanic rocks are intruded by a thick, widespread sheet of diorite porphyry and by several dikes and small irregular bodies of porphyritic basalt, which with the Elkhorn Mountains Volcanics are folded into a gentle northward-plunging syncline cut by several steep faults. Boulder batholith rocks intrude the west limb of the syncline; four small granitic bodies intrude the Elkhorn Mountains Volcanics and diorite porphyry. Unconformably overlying these rocks are poorly consolidated tuffaceous lake and stream deposits of Oligocene and perhaps younger Tertiary age, and Quaternary alluvium, stream terrace deposits, and colluvium.—*from* Author's abstract

10579 **Prych, Edmund A.; Hubbell, D. W.; Glenn, J. L.** Measurement equipment and techniques used in studying radionuclide movement in the Columbia River estuary, Chap. 28 *in* Coastal engineering, Santa Barbara Specialty Conf., 1965: New York, Am. Soc. Civil Engineers, p. 683–704, illus., 1966.

For an investigation of the movement of radionuclides in the Columbia River estuary flow velocities and directions throughout the entire depth at a single vertical are measured from an unanchored boat in about a minute with the new discharge measuring technique. Measured discharges agree fairly well with those measured by conventional methods. In situ measurements of radioactivity sorbed on the bed sediments are obtained with a radiation detector mounted in an underwater sled. Samples of water and suspended sediment are obtained for radionuclide and

sedimentation analyses with a high-volume sampler, and separated with a high-flow membrane filter system for analysis. Core samples of bed sediments are collected in depths up to 70 feet and flow velocities up to 5 feet per second with a portable vibratory sampler.—*from* Authors' abstract

10446 **Radcliffe, Dennis; Campbell, Finley A.** Beryl from Birch Portage, Saskatchewan: Canadian Mineralogist, v. 8, pt. 4, p. 493–505, illus., tables, 1966.

An X-ray diffraction pattern of beryl has been indexed and the observed reflections agree with the space group $P6/mcc$. Chemical analysis of 3 beryl crystals and 12 pegmatitic and aplitic rocks are reported. The chemical, physical, and optical properties of yellow and green beryl from Birch Portage are correlated, and compared with previously published data. This leads to the conclusion that the coloration may be associated with R_2O components. If these components occupy structural positions, the lattice may be expanded in the direction of c, and if they reside in the open channels of beryl, the lattice may be expanded in the direction of a. The terms 'C' type and 'A' type beryl are proposed. Birch Portage beryl falls in the latter category.—*from* Authors' abstract

Radtke, A. S. *See* Hewett, D. F. 00401

00364 **Ragan, Donal M.** Planar and layered structures in glacial ice: Jour. Glaciology, v. 6, no. 46, p. 565–567, 1967.

In metamorphic rocks a sharp distinction between planar structures (e.g. in schists) and layered structures (e.g. in banded gneisses) is generally made. This same distinction has not been maintained in descriptions of analogous structures in glacial ice. At least part of the problem lies with the use of the term *foliation*, which, unfortunately, has been applied to both types of structures. On historical and etymological grounds, as well as on the basis of widespread acceptance by petrologists and structural geologists, it is argued that foliation should apply to planar structures in both rocks and glacial ice.—Author's abstract

Rahm, David A. *See* Billings, Marland P. 10353

10619 **Ramdohr, Paul.** Die Eisen "Kügelchen" der Umgebung des Canyon Diablo-Kraters und ein Vergleich mit den "kosmischen Kügelchen" der Tiefseesediments [with English abs.]: Chemie Erde, v. 25, no. 4, p. 259–281, illus., 1966.

Microsopic investigations support Nininger's explanation for tiny globules of iron found around this Arizona crater. The globules are condensed in microseconds from clouds of supercritical gas of Fe, Ni, S and P, and form skeleton crystals of iron, the interstices filled with troilite and schreibersite. The iron itself forms sub-individuals which have a core of pure iron encrusted with Ni-richer parts more resistant to weathering. Some weathered globules consist of a very regular network of Ni-rich iron including the skeleton of troilite and schreibersite. In many cases the inner core contains relics of ϵ-iron in tabular and disk-like forms, showing weathering and cleavage in one direction only. Basal sections occasionally have hexagonal outlines. The remnant lamellae obviously formed at enormous pressures during the explosion.—G.D.C.

00416 **Ramspott, L. D.** Zeolites in the Georgia Piedmont: Georgia Acad. Sci. Bull., v. 25, no. 1, p. 18–24, table, 1967.

In the Georgia Piedmont chabazite, prehnite, albite, quartz, pyrite, and chlorite occur in an Alpine type fissure vein in gneiss in Clarke County; laumontite (leonhardite), prehnite, chabazite, and stilbite occur in fractures in Elbert County adamellite; stilbite is reported from a vein in metadacite in Lincoln County; and chabazite and stilbite have been found in drill cores from Putnam County. The collected material was identified by optical and X-ray methods. Zeolites here described are typical of hydrothermal vein and cavity fillings; pink shear zones are believed to represent hydrothermal avenues. It is suggested that a zeolite mineral facies may be recognized in veins and cavities superimposed on the higher-grade metamorphic and igneous facies of the Georgia Piedmont.—G.D.C.

00477 **Rancitelli, L.; Fisher, D. E.; Funkhouser, J.; Schaeffer, O. A.** Potassium–argon dating of iron meteorites: Science, v. 155, no. 3765, p. 999–1000, tables, 1967.

The potassium–argon age of the metal phase of Weekeroo Station iron meteorite, determined by neutron–activation analysis, is about 10^{10} years; it is similar to ages previously measured for other iron meteorites, but distinctly disagrees with a strontium–rubidium age of 4.7×10^9 years measured by other workers on silicate inclusions in this meteorite.—Authors' abstract

00531 **Rasetti, Franco; Theokritoff, George.** Lower Cambrian agnostid trilobites of North America: Jour. Paleontology, v. 41, no. 1, p. 189–196, illus., 1967.

Of the three genera based on Lower Cambrian agnostids, *Eoagnostus* Resser and Howell, 1938, is recognized as valid, and a new species, *E. acrorhachis*, is referred to it; *Archaeagnostus* Kobayashi, 1939, is a junior synonym of *Peronopsis* Hawle and Corda, 1847, and a new species, *P. evansi*, is described; *Mallagnostus* Howell, 1935, is excluded from the agnostids since the type and only known species, *Agnostus desideratus* Walcott, belongs to the family Eodiscidae. A few forms belonging to *Peronopsis* but too imperfectly known to name are described. Biostratigraphic evidence suggests that biofacies of the Taconic Lower Cambrian evolved from a transitional to a Pacific province type; Lower Cambrian agnostids of North America are associated with a Pacific province fauna which is probably of latest Early Cambrian age.—*from* Authors' abstract

10391 **Rasool, S. I.; McGovern, W. E.** Primitive atmosphere of the Earth: Nature, v. 212, no. 5067, p. 1225–1226, 1966.

Results of calculations on the temperature structure of a model of the primitive atmosphere suggest that during the early history of the Earth a reducing atmosphere could be stable against gravitational escape for as long as 10^9 yr. These results may help partly to resolve the controversy concerning the composition of the atmosphere of the Earth when the first living organisms are thought to have been synthesized.—D.B.V.

00327 **Rathbun, R. E.; Guy, H. P.** Measurement of hydraulic and sediment transport variables in a small recirculating flume: Water Resources Research, v. 3, no. 1, p. 107–122, illus., tables, 1967.

In a small recirculating flume, besides determining the average depth of flow over a river bed and the water–surface slope, sediment transport rate was determined by passing all the water–sediment mixture through a trap screened fine enough to hold the sand. The transport rate varied in a 10–fold range with respect to time. There was no particle movement on the plane bed before ripple formation; the mean velocity for cessation of particle movement (on the ripple bed) was about half that at which first movement occurred (on the plane sand bed).—G.D.C.

00558 **Raup, David M.** Geometric analysis of shell coiling—Coiling in ammonoids: Jour. Paleontology, v. 41, no. 1, p. 43–65, illus., 1967.

Ammonoids occupy only a small part of the geometric range available to spirally coiled organisms. Geometric form is defined by three parameters: W, the whorl expansion rate; D, the relative distance between the generating curve and the axis of coiling; and S, the shape of the generating curve. Computer constructions are used to visualize forms in geometric regions outside the ammonoid region. Within the ammonoid region, some geometries have evolved more often than others. The effects of shell geometry on the following functional factors may be used to interpret ammonoid morphology: efficiency in the use of shell material, body chamber length and shape, orientation in the life position, stability in the life position, shell strength, and streamlining.—*from* Author's abstract

Raveling, H. P. *See* Denison, Rodger E. 00612

00318 **Redmond, C. E.; Whiteside, E. P.** Some till–derived Chernozem soils in eastern North Dakota—[Pt.] 2, Mineralogy, micromorphology, and development: Soil Sci. Soc. America Proc., v. 31, no. 1, p. 100–107, illus., tables, 1967.

Mineralogical and micromorphological studies of three soil profiles representative of the Forman, Barnes, and an Intermediate soil Groups are presented. The mineralogy is used to evaluate the uniformity of the original materials of each soil. Calculations of the net changes in sand, silt, clay, $CaCO_3$ equivalent, organic matter and volume of two profiles and the individual horizons in each are presented and their interpretations are discussed. There is need for improving sampling techniques and better measures of the natural variability of the materials.—Authors' abstract

00319 **Redmond, C. E.; Omodt, H. W.** Some till-derived Chernozem soils in eastern North Dakota—[Pt.] 1, Morphology, genesis, and classification: Soil Sci. Soc. America Proc., v. 31, no. 1, p. 89–99, illus., table, 1967.

The macromorphology of three well-drained chernozem soils in eastern North Dakota that have developed in glacial till are described. Laboratory analyses of two profiles representative of each of these soil groups include: particle size distribution, pH, organic carbon, $CaCO_3$ equivalent, clay size carbonates, free iron oxides, and the shale and chert of the sand fractions. The development of these soils has involved: accumulation of organic matter and associated structure formation, redistribution of carbonates and soluble salts, color changes, and formation of prismatic finer textured B horizons by alternate wetting and drying and weathering in situ. Differences in magnitude of these changes account for the Forman, Intermediate, and Barnes soils.—*from* Authors' abstract

00455 **Reeder, H. O.; Bjorklund, L. J.; Dinwiddie, G. A.** Quantitative analysis of water resources in the Albuquerque area, New Mexico—Computed effects on the Rio Grande of pumpage of ground water, 1960–2000: New Mexico State Engineer Tech. Rept. 33, 34 p., illus., table, 1967.

From basic assumptions of water requirements in the Albuquerque area and aquifer characteristics, greatest lowering of water level from 1960–2000 is computed to be 86 feet in an area about 6 mi east of the city where water levels declined almost 11 feet from 1920–60. In a small area 9 mi northwest of the city levels are expected to decline 34 feet, although before 1960 there was practically no decline. Computed water-level declines will reverse the water-table gradient east of the Rio Grande, causing ground water to flow away from the river; the water table 5–8 mi east of the river at Albuquerque will be lower than the adjacent part of the river. About 80 percent of water pumped by the city from 1920–60 was derived from Rio Grande flow, either decreasing flow to, or increasing flow from, the river. From 1960–2000 between 71–76 percent of pumped water will be from the Rio Grande.—*from* Authors' abstract

00515 **Rees, O. W.** Chemistry, uses, and limitations of coal analyses: Illinois Geol. Survey Rept. Inv. 220, 55 p., illus., tables, 1966.

The mode of occurrence of various constituents of coal, the chemical and physical changes that take place during analysis, some of the difficulties that may be encountered during analysis and means of minimizing them are considered in this report. Uses of coal analyses and their limitations, both analytical and applied, also are discussed.—Author's abstract

Reesman, A. L. *See* Keller, W. D. 00608

10386 **Reid, Joseph L.** Zetes expedition: Am. Geophys. Union Trans., v. 47, no. 4, p. 555–561, illus., 1966.

During the Zetes expedition, the R. V. *Argo* logged 17,000 miles in the north Pacific Ocean, the investigations covering a wide range of oceanographic studies. Studies designated for each of the seven legs of the expedition are listed; work accomplished is described. The scientific party varied from 9 to 15 and included scientists from Japan and Canada as well as from the United States.—D.B.V.

00492 **Reid, Rolland R.; Greenwood, William R.** Mafic intrusive rocks in the St. Joe region, Idaho [abs.]: Northwest Sci., v. 41, no. 1, p. 58, 1967.

Reiher, Barbara J. *See* Matalas, N. C. 00328

Reso, Anthony. *See* Howe, Herbert J. 00605

10504 **Retallick, Harold J.** Geomorphology of the Domebo site, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie-Plains: Mus. Great Plains Contr., no. 1, p. 3–9, illus., 1966.

The Domebo mammoth kill site is located in an arroyo-like branch of Tonkawa Creek, Caddo County, Okla., on the eastern margin of the Great Plains. The site, at the headwaters of the Domebo Branch, is just north of a gypsum-capped (Permian Cloud Chief Formation) drainage divide; the north flowing tributaries of Tonkawa Creek descend from the divide in steep channels, cutting rugged arroyos and badland erosion features in the soft sandstones of the Permian Rush Springs Formation and Quaternary alluvium. Three interruptions in the longitudinal profile of Domebo Branch may represent nick points indicating cyclic uplift. Terrace remnants indicate Pleistocene aggradation and degradation cycles, followed by active downcutting in historical time. The mammoth could have been driven into Domebo Canyon from the larger river bottoms to the north.—V.M.J.

Rexroad, Carl B. *See* Burger, Ann M. 10611

Rhoad, Donald C. *See* Stanley, Daniel J. 00371

10471 **Rhodes, F. H. T.; Häntzschel, Walter; Müller, K. J.; Fisher, D. W.; Teichert, Curt.** Treatise on invertebrate paleontology—Part W, [Miscellanea] Conodonts, conoidal shells, worms, trace fossils—Comments and additions: Kansas Univ. Paleont. Contr.—Paper 9, 17 p., illus., 1966.

Up-to-date information supplemental to Pt. W of the Treatise (Joint Comm. Invertebrate Paleontology, 1962; includes papers by W. H. Hass, W. Häntzschel, D. W. Fisher, B. F. Howell, F. H. T. Rhodes, K. J. Müller, and R. C. Moore) is here presented in five parts: comments on conodonts (Rhodes and Müller, p. 2–5); review of conodont publications 1958 to July, 1965 (Rhodes, p. 5–8); conoidal shells of uncertain affinities (Fisher, p. 8–10); annelid *Serpuloides* Sowerby (Teichert, p. 10); recent contributions to knowledge of trace fossils and problematica (Häntzschel, p. 10–17).—V.M.J.

Ribbe, Paul H. *See* Lipps, Jere H. 00382

Ribbe, Paul H. *See* Cohen, Lewis H. 10424

Richter, D. H. *See* Murata, K. J. 10371

Riecken, F. F. *See* Runge, E. C. A. 10408

10614 **Riecker, R. E.** Bibliography of experimental rock deformation, second edition, Pt. 2: U.S. Air Force Cambridge Research Labs. Spec. Rept. 35(2) (AFCRL-65-740 (2)), 10 p., 1966.

This first supplement to the second edition of the Bibliography (1965) lists 111 cross-referenced research articles in 29 categories.—E.S.L.

00616 **Rigby, J. Keith.** A new polyactinal sponge from the Antelope Valley Formation (Ordovician) in the Toquima Range, Nevada: Jour. Paleontology, v. 41, no. 2, p. 511–515, illus., 1967.

A new genus and species of heteractinidian sponge, *Toquimella curvata*, from the famous Ike's Canyon locality which contains one of the most varied Ordovician sponge faunas in western North America is described. This species is assigned to the relatively new sponge class Heteractinida.—J.P.

10450 **Rinehart, John S.** Reaction of rock to impulsive loads [with French and German abs.], *in* Internat. Soc. Rock Mechanics Congress, 1st, Lisbon, 1966, Proc., V. 2:

Lisbon, Portugal, Laboratório Nacional Engenharia Civil, p. 105–109, illus., table, 1966.

Rocks tend to crush and fracture in a different manner and for different reasons when subjected to the dynamic loading generated by explosions and impacts than when statically loaded. Often the stresses that cause the rock to fail develop because rock is inhomogeneous in structure. This paper discusses some aspects of influence of layers, voids, and inclusions on rock fracturing. —*from* Author's abstract

00457 **Robertson, Charles E.** The Elsey Formation and its relationship to the Grand Falls chert: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 38, 62 p., illus., 1967.

The name "Grand Falls chert" is restricted to a distinctive body of massive chert which crops out at and in the immediate vicinity of Grand Falls on Shoal Creek south of Joplin, Mo. The chert body is considered to be the result of compaction through solution and removal of the host carbonate rock and to be of limited areal extent. It is recommended that usage of the name "Grand Falls" be discontinued except for this limited chert unit, and that the widespread mappable, sedimentary unit which immediately overlies the Reeds Spring Formation and which has previously been referred to as the "Grand Falls Formation" in southwestern Missouri be given the name "Elsey Formation."—Author's abstract

00444 **Robinson, G. D.** Geologic map of the Toston quadrangle, southwestern Montana: U.S. Geol. Survey Misc. Geol. Inv. Map I–486, 2 sheets, scale 1:24,000, sections, text, 1967.

In a 1963 paper by Robinson on the Three Forks quadrangle (U.S. Geol. Survey Prof. Paper 370), detailed stratigraphic information on most of the map units was presented; exceptions and fuller information relating to the Toston quadrangle are noted here. Interpretation of structural relations is based mainly on geologic mapping but has been influenced by aeromagnetic and gravity data. The second sheet of the map set contains five cross sections.—M.C.M.

00506 **Robison, Richard A.** Ontogeny of *Bathyuriscus fimbriatus* and its bearing on affinities of corynexochid trilobites: Jour. Paleontology, v. 41, no. 1, p. 213–221, illus., table, 1967.

Protaspid morphology of this species [from late Middle Cambrian of western Utah] is similar to that of some ptychopariid trilobites. Subsequent corynexochid development parallels that of ptychopariids except that some characters present in the protaspid or meraspid periods of ptychopariids are found in the holaspid period of corynexochids. Major differences between holaspides of corynexochids and ptychopariids appear to result primarily from differential growth rates. Protaspid similarities suggest that the two groups are biologically closely related and current classifications need to be revised to reflect this relationship. —*from* Author's abstract

00432 **Roddick, J. A.** Tintina Trench: Jour. Geology, v. 75, no. 1, p. 23–32, illus., 1967.

Tintina trench, excavated along the Tintina fault zone, extends about 600 miles from southeastern Yukon Territory to Yukon Flats in Alaska. Movement along the fault zone appears to have been right lateral, and estimates of displacement range from 220 to 260 miles, depending on how offset stratigraphic units are matched up. Matching of regional structural trends on each side of the Tintina fault also requires right lateral displacement of from 220 to 260 miles. The earliest movement along the fault apparently took place in early Paleozoic time, but the main period of movement was probably between Middle Jurassic and Paleocene time, principally in Late Cretaceous time.—E.T.R.

00606 **Rodriguez, Joaquin; Gutschick, Raymond C.** Brachiopods from the Sappington Formation (Devonian–Mississippian) of western Montana: Jour. Paleontology, v. 41, no. 2, p. 364–384, illus., tables, 1967.

The Sappington spans the Devonian–Mississippian boundary. Two brachiopod genera occur in the lower dark shales of Devonian age; 18 genera in the Mississippian part. Two species are new: *Acanthocrania spinosa*, *Beecheria paraplicata*. Correlation is with the upper Saverton Shale and the Louisiana Limestone, now considered to be Mississippian.—R.E.G.

00411 **Roedder, Edwin.** Metastable superheated ice in liquid-water inclusions under high negative pressure: Science, v. 155, no. 3768, p. 1413–1416, illus., table, 1967.

In some microscopic inclusions (consisting of aqueous liquid and vapor) in minerals, freezing eliminates the vapor phase because of greater volume occupied by the resulting ice. When vapor fails to nucleate again on partial melting, the resulting negative pressure (hydrostatic tension) inside the inclusions permits the existence of ice I crystals under reversible, metastable equilibrium, at temperatures as high as +6.5°C and negative pressures possibly exceeding 1,000 bars.—Author's abstract

10460 **Roeder, P. L.; Osborn, E. F.** Experimental data for the system MgO–FeO–Fe_2O_3–$CaAl_2Si_2O_8$–SiO_2 and their petrologic implications: Am. Jour. Sci., v. 264, no. 6, p. 428–480, illus., 1966.

Liquidus equilibrium relations among olivine, pyroxene, anorthite, magnetite, tridymite, liquid, and a gas phase have been determined at 1 atm total pressure and at oxygen partial pressures ranging from 10^{-11} to $10^{-0.7}$ atm. At PO_2 values as low as 10^{-9} atm, anorthite, pyroxene, magnetite, and tridymite coexist with liquid which represents the end result of fractional crystallization of basalt-like liquids in the system. The system reported represents addition of anorthite to the four component system MgO–FeO–Fe_2O_3–SiO_2 investigated by Osborn, 1959. The general nature of crystallization is not changed by addition of anorthite, but liquid compositions, temperatures, and oxygen partial pressures are much closer to those of basalts and andesites. However, for constant oxygen content, the course of fractional crystallization is toward ferrogabbroic liquids and low values for PO_2.

10596 **Rogers, Thomas H.** (compiler). Geologic map of California, Olaf P. Jenkins edition—San Jose sheet: [San Francisco, Calif.] California Div. Mines and Geology, scale 1:250,000, separate explanatory chart, 1966.

The chart includes an index to geologic mapping used in the compilation of the San Jose sheet and a table of stratigraphic nomenclature.—M.C.M.

10612 **Rooney, Lawrence F.** The Salem Limestone as dimension stone, *in* Excursions in Indiana geology—Assoc. Am. State Geologists, 58th Mtg., 1966: Indiana Geol. Survey Guidebook 12, p. 62–67, illus., 1966.

The Mississippian Salem Limestone was deposited along the margins of a shallow sea as a complex network of lenticular bodies of skeletal debris, which cemented into a wedge of rock. Thickest units of dimension-stone quality are in Monroe and Lawrence Counties. The color shades from gray to buff, and some is stylolitic. Uses are discussed. About 52 million tons have been produced, with peak production in the 1920's.—E.S.L.

00495 **Rose, E. R.** Vanadium occurrences in Canada: Canada Geol. Survey Paper 66-57, 22 p., illus., tables, 1967.

The general nature of vanadium, its uses, occurrences, and types of occurrences are outlined. Methods of identification and a field chemical test for vanadium are described. By means of the latter it has been shown that vanadium is of more widespread occurrence in Canadian rocks than hitherto recognized. The world outlook for vanadium is summarized, and potential sources of vanadium are described by provinces and territories.—Author's abstract

10620 **Rose, Robert H.** Yosemites of the Kings River: Natl. Parks Mag., v. 40, no. 229, p. 4–9, illus., 1966.

Similarities between the great chasms of the Kings River country and Yosemite Valley, less than 100 miles to the northwest, are accented in Kings Canyon and

Tehipite Valley. They are portions of valleys of major rivers flowing westward from their sources near the crest of the Sierra Nevada down into the Great Valley of California, transformed into gigantic U-shaped troughs by Pleistocene glaciers. Even the underlying rocks consist of closely related types of granite, exfoliated into the domes of the walls. Tehipite Valley is described briefly with some discussion of the geological processes; it and the Cedar Grove sequoia tract were added to Kings Canyon National Park in 1965, as suggested by John Muir who noted several times the grandeur of the yosemites of the Sierra Nevada.—G.D.C.

Rosenberg, D. *See* Sharma, G. D. 10539

00406 **Rosenberg, P. E.; Mills, J. W.** A mechanism for the emplacement of magnesite in dolomite—A reply [to discussion by W. Johannes, 1967]: Econ. Geology, v. 62, no. 1, p. 149–151, 1967.

00397 **Ross, Charles A.** Stratigraphy and depositional history of the Gaptank Formation (Pennsylvanian), West Texas: Geol. Soc. America Bull., v. 78, no. 3, p. 369–384, illus., 1967.

The Late Pennsylvanian Gaptank Formation is revised to exclude the *Chaetetes*-bearing limestone member, which is transferred to the Haymond Formation. The Gaptank thus includes a conglomerate member at its base, a middle predominantly sandstone and shale member, and an upper limestone member. The Gaptank was deposited on the northern slope of a major Pennsylvanian orogenic thrust belt and represents sediments laid down in environments that were continually modified by changes in sea level, subsidence, warping, and basinward migration. The Gaptank deposits include a number of cyclically repeated carbonate tracts, which include shallow shelf (undaform), shelf-edge (clinoform), and deeper water (fondoform) limestones and associated shales. Undaform-edge sand bodies extended the edge of the shelf basinward at times of lowered sea level.—H.C.W.

Ross, D. R. *See* Coleman, R. G. 10420

00556 **Ross, June Phillips.** Fossil problematica from Upper Ordovician, Ohio: Jour. Paleontology, v. 41, no. 1, p. 37–42, illus., 1967.

Fossil problematica observed . . . in Upper Ordovician limestone are small hollow cylindrical calcitic structures consisting of a longitudinal series of imbricate rings. The two species, *Ancientia ohioensis* n. gen et n. sp. and *A. fortensis* n. sp., from the Waynesville Formation, Richmond Group, Cincinnatian Series, are assigned to family Ancientidae n. fam., but their taxonomic position in phylum, class, or order is unknown. This family has gross external similarity with calcitic structures grouped in the Treatise of Invertebrate Paleontology (W) Miscellanea as "Other small conoidal shells" of family Cornulitidae. The two families differ greatly in their microscopic structures; the family Ancientidae has a laminate structure in each of the dentate rings and the laminae are not continuous from one ring to the next; the family Cornulitidae has a vesicular wall structure.—Author's abstract

00623 **Ross, June Phillips.** Evolution of ectoproct genus *Prasopora* in Trentonian time (Middle Ordovician)in northern and central United States: Jour. Paleontology, v. 41, no. 2, p. 403–416, illus., tables, 1967.

Morphologic changes, most particularly in the size, shape, and arrangement of the cystiphragms, in four species of the ectoproct genus *Prasopora* Nicholson and Etheridge indicate an evolution of the species *P. simulatrix* Ulrich, *P. shawi* Sparling, *P. sardesoni* Sparling, and *P. selwynii* Nicholson during late Trentonian time. In early and middle Trentonian time, *P. simulatrix* showed great morphologic diversity but no persistent modal change. In late Trentonian time, three additional species, *P. shawi, P. sardesoni, and P. selwynii*, evolved; they follow a stratigraphic sequence and have a short stratigraphic range and a wide geographic distribution. Statistical methods using linear statistical models do not appear applicable for determining the variation in populations of these species.—Author's abstract

Rouse, G. E. *See* Nasmith, H. 00398

Rouse, Glenn E. *See* Martin, Helene A. 10647

Rouse, John T. *See* Denison, Rodger E. 00612

Rowe, J. J. *See* Fournier, R. O. 10476

00315 **Rubin, J.** Numerical method for analyzing hysteresis-affected, post-infiltration redistribution of soil moisture: Soil Sci. Soc. America Proc., v. 31, no. 1, p. 13-20, illus., 1967.

An especially devised numerical procedure applied to the Darcian model of soil moisture flow makes it possible to analyze the post-infiltration redistribution of water in semi-infinite, vertical soil columns. The method takes into account the effects of hysteresis by making it possible to find, within the hysteretic system of curves, the unique curve which characterizes moisture transformations at each soil depth. The method can be applied to cases in which the moisture flux at soil surface is zero as well as to those in which the redistribution on is accompanied by constant-rate evaporation. The results obtained by applying the new method to data on moisture retention and conductivity of a sandy soil demonstrate the importance of hysteresis in the redistribution processes.—Author's abstract

00445 **Rucker, James B.; Stiles, Newell T.; Busby, Roswell F.** Sea-floor strength observations from the DRV ALVIN in the Tongue of the Ocean, Bahamas: Southeastern Geology, v. 8, no. 1, p. 1-8, illus., 1967.

The deep research vehicle ALVIN was employed to study the strength of the deep sea sediments in the Tongue of the Ocean. Variously configured free fall test clumps were deployed from a surface vessel. The impact sites of the clumps were then located by the ALVIN by means of light-acoustic beacons arrached to the test clumps. The clumps penetrated approximately three to four inches into the bottom, while the calculated penetration predicted for the clumps ranged from 7 to 19 inches. Much additional work will be required before reliable penetration predictions can be made for cases of dynamic loading of submarine sediments.—Authors' abstract

00565 **Rucklidge, J.** A computer program for processing microprobe data: Jour. Geology, v. 75, no. 1, p. 126, 1967.

A Fortran IV computer program has been designed to provide a complete compositional analysis of any mineral, given electron probe intensity data for all the elements in the unknown and comparative data for the same elements in a series of standards. Corrections are made for absorption, X-ray generation efficiency, and fluorescence effects.—A.T.M.

Ruddiman, William F. *See* Heezen, Bruce C. 10525

10408 **Runge, E.C.A.; Riecken, F. F.** Influence of natural drainage on the distribution and forms of phosphorous in some Iowa prairie soils: Soil Sci. Soc. America Proc., v. 30, no. 5, p. 624-630, illus., table, 1966.

Total, inorganic, and available P were determined for 12 loess-derived prairie soil profiles. The amount of total phosphorous is high near the surface, minimum from 1 to 3 feet, maximum from 3 to 6 feet, and nearly uniform below 6 to 7 feet; higher amounts near the surface are due to organic phosphorous. The amount of OP in poorly drained soils is about half that in better drained ones. Differences in organic carbon/OP ratios are appreciable, with poorly drained soils having the higher ratios. Differences in available phosphorous may be interpreted when pH, extractable Fe and Al, rooting depths of plants, TP and OC/OP ratios are considered. Phosphorous differences between soils of southeast and southwest Iowa are appreciable. The role of P in soil genesis is discussed.—*from* Authors' abstract

00409 **Russell, Dale A.** Cretaceous vertebrates from the Anderson River, N.W.T.: Canadian Jour. Earth Sci., v. 4, no. 1, p. 21-38, illus., tables, 1967.

Vertebrate remains have been recovered from two horizons in late Cretaceous strata along the east bank of the Anderson River at latitude 69° N. The lower horizon

has produced fauna very similar to that of the Niobrara Chalk in western Kansas, including mosasaurs, plesiosaurs, and abundant toothed birds. The upper horizon has yielded a moderately short-necked plesiosaur of cimoliasaurian affinities. These vertebrates lived in or near a strait linking the Arctic Ocean with the interior sea in very late Cretaceous time.—Author's abstract

00359 **Russell, K. L.; Deffeyes, K. S.; Fowler, G. A.; Lloyd, R. M.** Marine dolomite of unusual isotopic composition: Science, v. 155, no. 3759, p. 189–191, illus., tables, 1967.

A piston core taken off the coast of Oregon in 358 m of water contained an indurated calcareous layer composed partly of dolomite with a composition $Ca_{58}:Mg_{41.5}$. Dolomites of this chemical composition are typical of the supratidal environment. However, the dolomite has isotopic composition O 18 = 5.8 per mille, C 13 = 35.1 per mille relative to the Chicago PDB 1 standard. The unusual carbon isotope ratio is similar to that of calcites produced as a byproduct of bacterial breakdown of hydrocarbons.—Authors' abstract

10508 **Russell, L. S.** The changing environment of the dinosaurs in North America: Adv. Sci., v. 23, no. 110, p. 197–204, illus., 1966.

On this continent a succession of dinosaurian remains, although not continuous, spans almost their whole existence. Glimpses of their environment are based mainly on evidence of stream channel and flood plain deposits. Such environments varied from semi-arid Late Triassic in the Newark Series of eastern North America and Chinle Formation of the southwest, to semiarid, then more humid Jurassic as indicated by decomposed mineral grains in the Morrison Formation of Colorado, Wyoming, and Utah. Cretaceous climate became more like that of today, as displayed in the Kootenai (Cloverly) Formation in Montana and later beds grading westward (including Alberta) into some of the richest dinosaur remains in the world. Change in dentition is connected with that in plant life, extinction of species to seasonal fluctuations in climate.—G.D.C.

00396 **Rydstrom, Hubert O.** Interpreting local geology from radar imagery: Geol. Soc. America Bull., v. 78, no. 3, p. 429–436, illus., 1967.

Intensity of radar return energy is dependent on manner of radar illumination, surface roughness, and geometry of the object. Geologic interpretation is discussed and illustrated relative to these concepts.—A.G.

10448 **Sabels, Bruno E.** Climatic variations in the tropical Pacific as evidenced by trace element analysis of soils, *in* Pleistocene and post-Pleistocene climatic variations in the Pacific area, a symposium—Pacific Sci. Cong., 10th, Honolulu, 1961: Honolulu, Hawaii, Bishop Mus. Press, p. 131–151, illus., tables, 1966.

Chemical analysis of cultural layers in caves, supported by carbon dating, and by evidence of artifacts, can afford direct evidence of past climates. In 1961, dung from Rampart Cave, Ariz., was analyzed for 14 elements, and the curve of the abundance values coincided with climatic maxima and minima as evidenced by pollen. Manganese abundance is especially sensitive to climatic changes because of the profoundly different properties of different oxidation states. Six samples from excavation sites in Hawaii, four from the Marquesas Islands, and ten from Borneo were studied. The trace-element evidence, discussed and compared with other supporting evidence, appears to agree with that from Arizona. Variations in climate may have triggered man's exploration into the Pacific.—E.S.L.

00617 **Saint Jean, Joseph.** Some observations and impressions of paleontology in the Soviet Union: Jour. Paleontology, v. 41, no. 2, p. 515–522, 1967.

It is concluded that there are some areas where Soviet paleontology is ahead of North American paleontology, and other areas where the reverse is true. Equipment and facilities are often not as good as in American laboratories, but more highly skilled technical assistance is available. Quality of illustrations is usually poor in Russian papers, and many works are published in very limited editions.—J.F.M.

00479 **Salotti, Charles A.** A high resolution versatile atomic absorption spectrometer: Georgia Acad. Sci. Bull., v. 25, no. 1, p. 43–56, illus., tables, 1967.

Trace element analysis has been greatly simplified by recent instrumental developments in atomic absorption spectroscopy. The advantages of the described instrument over commercially available equipment are: a more stable and much brighter hollow cathode source than the regular lamp, particularly because helium can be used as the filler gas; a greater flexibility in the selection and arrangement of the atomizer–burner system, with one of the burner arrangements providing an extended absorption path; increased sensitivity in the signal monitoring system; convenience and low cost of preparing suitable cathodes for the demountable lamp; and indefinite lamp life.—G.D.C.

10545 **Sammel, E. Z.; Baker, J. A.; Brackley, R. A.** Water resources of the Ipswich River basin, Massachusetts: U.S. Geol. Survey Water-Supply Paper 1826, 83 p., illus., tables, geol. map, 1966.

Large supplies of ground water may be obtained under water-table conditions from stratified glacial drift that forms the principal ground-water reservoir of the Ipswich River basin. These deposits, filling valleys in about 31 percent of the basin, vary from less than 50 feet to 200 feet in thickness. Ground-water withdrawals could be sustained at a rate at least five times greater than the 1960 rate of 4.9 mgd. Small but reliable supplies of ground water for domestic use may be withdrawn almost anywhere. Levels show no long-term trend since 1939, and although large fluctuations occur each year, the reservoir is replenished annually to full capacity. Chemical quality of ground and surface water is generally satisfactory for most uses. Surface- and ground-water resources are closely related and this implies the necessity of a basinwide approach to hydrologic problems.—*from* Authors' abstract

00538 **Sample, Raymond D.** Geologic map of the Lamasco quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-608, scale 1:24,000, section, text, 1967.

The St. Louis and Warsaw Limestones have been quarried in the Lamasco quadrangle locally for construction material, roadbeds, and riprap. Gravel and sand from the Tuscaloosa Formation have been used for road bases on secondary roads. These deposits are as much as 40 feet thick. Low-grade iron deposits, mixed limonite and hematite cementing gravel and chert residuum were mined during the middle and late 1800's from open pits. No known test holes have been drilled in search of oil and gas.—M.C.M.

00366 **Sander, N. J.** Classification of carbonate rocks of marine origin: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 325–336, tables, 1967.

An objective classification of carbonate rocks is attempted and succeeds partly by using measured particle size as the basis for subdivision into major categories. Less objectively, it provides a method of distinguishing degrees and kinds of alteration of rock texture by the several processes of diagenesis. A still greater degree of subjectivity is introduced unavoidably in the identification of the grains and crystals comprising the carbonate.—*from* Author's abstract

Sarmah, Survya K. *See* Berg, Joseph W., Jr. 10360

00418 **Savage, C. N.** Geology and mineral resources of Bonner County: Idaho Bur. Mines and Geology County Rept. 6, 131 p., illus., tables, geol. maps, 1967.

Glaciated Bonner County, in northern Idaho, has uplands of igneous and metamorphic rocks, narrow to broad lowlands, and numerous lakes. Bedrock materials are Precambrian metasedimentary Belt Series and pre-Belt(?) rocks; Cambrian and younger sedimentary and metamorphic rocks; Cretaceous–Tertiary quartz monzonite, granodiorite, and quartz diorite of the Kaniksu batholith; mafic dikes and sills, and felsic dikes of several ages. The Quaternary mantle is glacial drift and fluviatile deposits. Major wrench faults are bounded by mosaic, bedding plane, and mineralized block faults, producing the Purcell trench. Sand and gravel, dimension stone, limestone, silica, and peat are of past and potential value; and

metallic minerals, in fissure veins and massive and disseminated replacements in limy or siliceous metasediments.—G.D.C.

Sawhney, B. L. *See* Boyle, J. R. 00358

10362 **Sawhney, B. L.** Kinetics of cesium sorption by clay minerals: Soil Sci. Soc. America Proc., v. 30, no. 5, p. 565–569, illus., 1966.

Time course and processes in the sorption of cesium from dilute solutions by illite, montmorillonite and vermiculite saturated with Ca or K and in the absence of excess saturating cation were investigated. Rapid sorption by montmorillonite is attributed to its expanded lattice which makes all exchange sites equally available. Since sorption by illite is limited to the external planar surfaces and interlattice edges only, equilibrium is quickly reached; but the Cs sorbed by vermiculite did not reach equilibrium even after 500 hours. Increased sorption by Ca–vermiculite is attributed to different rates by different exchange sites; decreased by K–vermiculite is perhaps associated with collapse of the partially hydrated vermiculite in suspension.—*from* Author's abstract

Schaeffer, O. A. *See* Rancitelli, L. 00477

00512 **Schalk, Marshall.** Sand models for structural geology: Jour. Geol. Education, v. 15, no. 1, p. 18, 1967.

The elementary geology course at Smith College has included a structure laboratory where topography is modeled in fine damp sand, with rock outcrops represented by colored slate chips oriented to show dip and strike. The set-ups can be either prepared in advance with an assignment to work out structure and to make cross sections, or the students can model the topography and place the chips from areal maps.—E.S.L.

00326 **Scheidegger, A. E.** On the topology of river nets: Water Resources Research, v. 3, no. 1, p. 103–106, illus., 1967.

Graph theory can be applied to the topology of river systems. Such applications, in particular, show how the possible different river systems of a given order can be enumerated.—Author's abstract

00503 **Schemel, Mart P.** Investigation of selected lower Pliocene and Pleistocene deposits in northwestern Oklahoma: Oklahoma Geology Notes, v. 27, no. 2, p. 24–33, illus., table, 1967.

Measured sections and descriptions are given for six exposures of the Laverne Formation (Pliocene), and three Pleistocene diatomaceous lake deposits in Beaver and Harper Counties in the Panhandle.—E.S.L.

Schlee, John S. *See* Moench, Robert H. 00420

10534 **Schmalz, Robert F.** Surface energy and textural equilibria in sediment–seawater systems [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 2, 1966.

10538 **Schmalz, Robert F.** Evaporite deposition in a thermodynamically open system [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 12, 1966.

00609 **Schmidt, Ruth A. M.** New generic assignments for some Pleistocene Ostracoda from Alaska: Jour. Paleontology, v. 41, no. 2, p. 487–488, illus., 1967.

Ostracodes from the Gubik Formation (Pleistocene) from the Point Barrow area were studied. The generic assignments of some species were changed. *Pseudocythereis simpsonensis* Swain 1963 is assigned to *Echinocythereis* Puri and *Cletocythereis noblissimus* Swain 1963 is assigned to *Acanthocythereis* Howe.—R.C.D.

00434 **Schmincke, Hans-Ulrich.** Fused tuff and pépérites in south-central Washington: Geol. Soc. America Bull., v. 78, no. 3, p. 319–330, illus., table, 1967.

The Pomona Basalt of the Columbia River Basalt overlies a vitric tuff of the Selah Member of the Ellensburg Formation. In many places, this airfall tuff was welded at the contact from the heat and pressure of the overlying basalt. Texture and minerals (mainly Na-sanidine and cristobalite) formed in the tuff during and after welding are identical to those of welded ash-flow tuff. Heat conduction from the lava could have accomplished the welding, as shown by calculations, although water vapors aided greatly in heat transfer. Welding was completed prior to deuteric crystallization of the Pomona Basalt. In other places, where the tuff was probably thicker, the Pomona flow burrowed into the tuff, fragmented it, and formed breccias (pépérites).—R.A.L.

Schneider, Allan F. *See* Burger, Ann M. 10611

10562 **Schoeppel, R. J.; Thrasher, J. E.** Laboratory study of induced polarization in sandstone rocks with varying salinity and shalyness, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. T1–T42, illus., tables, 1966.

The effect of induced polarization on the electrical conductivity of rock samples is studied using a variable frequency (reversed square wave) technique while varying the concentration of saturating NaCl solution and shalyness of the samples. Induced polarization effects are analyzed from the recorded wave forms for frequency variations between 0.2 cps and 30 cps. The rock samples are further characterized by their porosity, air permeability, and cation exchange capacity (CEC). The study found that the induced polarization effect increases with 1, increasing permeability, 2, decreasing shalyness (CEC), 3, increasing salinity, 4, increasing porosity, and 5, decreasing frequency. These findings are in agreement with prior frequency domain studies and theory. It is noted that induced polarization effects observed using variable frequency techniques may vary significantly from observations using pulse-transient techniques.—Authors' abstract

Scholl, David W. *See* Buffington, Edwin C. 10530

00400 **Schumm, S. A.** Rates of surficial rock creep on hillslopes in western Colorado: Science, v. 155, no. 3762, p. 560–562, illus., 1967.

The average rate of downslope movement of rock fragments on shale hillslopes is directly proportional to the sine of the slope angle or that component of the gravitational force which acts parallel to the hillslope. The rates of surficial rock creep range from a few millimeters per year on a 3-degree slope to almost 70 mm per year on a 40-degree slope, but these rates vary with natural variations in soil characteristics and microclimate, as well as with accidental disturbances.—Author's abstract

00542 **Schwartz, Maurice L.** The Bruun theory of sea-level rise as a cause of shore erosion: Jour. Geology, v. 75, no. 1, p. 76–92, illus., table, 1967.

Wave basin laboratory profiles and field profiles at two beaches were examined to test the theory of Bruun, which holds that, as sea level rises, (a) the beach profile is displaced shoreward, (b) material eroded from the upper beach is deposited on the nearshore bottom, and (c) the rise of that bottom from deposition is equal to the rise in sea level. Data from both laboratory and field tests are regarded by the writer as supporting the theory, which he proposes be known as "Bruun's Rule".—D.R.M.

10377 **Scott, Robert.** Origin of chemical variations with ignimbrite cooling units: Am. Jour. Sci., v. 264, no. 4, p. 273–288, illus., tables, 1966.

Deuteric alteration within large compound ignimbrite cooling units of east-central Nevada redistributed major elements in reactive volcanic glass, creating pronounced vertical chemical variations. K-Na exchanges and Mg and Fe redistribution were the most distinctive deuteric alteration phenomena. Weathering, which is

superimposed over the deuteric alteration pattern, affected the more porous zones primarily by leaching sodium and causing growth of Ca- montmorillonite. Local hydrothermal fluids added potassium and removed sodium in the plagioclase phenocrysts and volcanic glass.—*from* Author's abstract

00493 **Scott, W. Frank; Clem, Richard.** A mammoth from the Touchet beds near Walla Walla, Washington [abs.]: Northwest Sci., v. 41, no. 1, p. 60–61, 1967.

10556 **Seevers, D. O.** A nuclear magnetic method for determining the permeability of sandstones, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. L1–L14, illus., 1966.

The Nuclear Magnetism Log (NML) provides a measure of the fluid content (FFI) and the thermal relaxation time (T_1) for the fluid in the porous rocks penetrated by the well bore. This paper describes a method for determining the specific permeability of sandstones using the log-derivable quantities FFI and T_1. The physical models and mathematical derivations which are used to relate permeability to FFI and T_1 are given in detail. The results of laboratory measurements on powder packs and a large number of sandstone cores with a wide range of permeabilities are given and the permeabilities determined by this method are compared with those obtained by conventional flow methods.—Author's abstract

10477 **Seguin, Maurice.** Instability of $FeCO_3$ in air: Am. Jour. Sci., v. 264, no. 7, p. 562–568, illus., 1966.

The rate of dissociation of $FeCO_3$ to α-Fe_2O_3 in air over the temperature range 25° to 300°C is practically independent of the initial amount of material and is a function of grain size and temperature. The order of reaction is approximately, but not exactly, one. The activation energy at 25°C is between 9.5 and 11.1 Kcal $mole^{-1}$. The time of complete dissociation at 25°C is approximately 35 years for 300 mesh grain size, 65 years for −200 to +300 mesh, 370 years for −60 to +100 mesh, and many thousands of years for an ideal crystal three inches across. Metastability of $FeCO_3$ of 25°C is explained by a thin surface layer of hexagonal close-packed α-Fe_2O_3 in the same way as the metastability of Al surrounded by a coating of Al_2O_3.

10539 **Sharma, G. D.; Rosenberg, D.; Hood, D. W.** Silicate dissolution in glacially-fed inlets [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 19, 1966.

Shaver, Robert H. *See* Burger, Ann M. 10611

Shaw, David M. *See* Donn, William L. 00336

Sherwood, W. C. *See* Crenshaw, A. B. 10666

Shor, George G., Jr. *See* vonHuene, Roland. 10529

10651 **Shrock, Robert R.** A cooperative plan in geophysical education—The GSI Student Cooperative Plan, the first fifteen summer programs, 1951–1965: Dallas, Tex., Geophys. Service Inc., 143 p., illus., tables, 1966.

The Plan was started in 1951 to provide summer field training for 15–20 selected college students, interested in a career in exploration geophysics, by employing them as regular members of field parties after a few days of orientation. Appendices give data on these participants and assisting personnel, as well as programs of the 15 sessions.—E.S.L.

10409 **Sibley, E. A.; Yamane, G.** A simple shear test for saturated cohesive soils, *in* Vane shear and cone penetration resistance testing of in-situ soils—ASTM Pacific Area Natl. Mtg., 5th, Seattle, Wash., 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 399, p. 39–47, illus., 1966.

A simple torsional vane shear device has been developed which provides a reliable and rapid measure of the shear strength of saturated cohesive soils. This device can be used both in the field and in the laboratory. It is lightweight, inexpensive, and easy to use. For an extensive foundation investigation with a large laboratory testing program, the torsional vane shear device will provide rapid results and will supplement the over-all program. For small investigations, this device can be used in evaluating site conditions and may reduce or, in some cases, eliminate laboratory testing. This paper describes the development and application of the device [on Bootlegger Cove clay, Alaska].—Authors' abstract

00335 **Simmons, Gene.** Interpretation of heat flow anomalies—[Pt.] 1, Contrasts in heat production: Rev. Geophysics, v. 5, no. 1, p. 43–52, illus., 1967.

A relation between gravimetric and thermal anomalies, $Q = F(A/2\pi G\rho)$, where Q is the rate of heat flow, A is the rate of heat production per unit volume, G is the gravitational constant, ρ is density, and F is the gravitational attraction, is used to obtain theoretical surface heat flow anomalies for bodies from the analogous theoretical gravity anomalies. Results are collected for several geometrical shapes, and the application to digital computation of sources of arbitrary shape is indicated. The same relation may be used to verify that a gravity anomaly and a heat flow anomaly are caused by the same body.—Author's abstract

10555 **Simmons, Gene.** Temperature logging and heat flow, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. I1–I9, illus., 1966.

Temperatures are logged in wells for many reasons; an unusual use of temperature data is for the measurement of the rate of heat flowing from the interior of the earth to the surface. For this use, the requirements are stringent: the well must be in approximate thermal equilibrium, core must be available, and temperatures must be measured with precision of about 0.01°C. About 150 measurements of heat flow in the United States are currently underway. Preliminary results are reported.—Author's abstract

Simpson, E. C. *See* Barrows, H. L. 10435

00387 **Singh, S. Shah; Brydon, J. E.** Precipitation of aluminum by calcium hydroxide in the presence of Wyoming bentonite and sulfate ions: Soil Science, v. 103, no. 3, p. 162–167, illus., tables, 1967.

In the absence of clay, the ion product $(Al)(OH)^3$ was $10^{-32.9}$ and constant for about six months. The precipitate was amorphous to X-ray diffraction. When clay was present, the magnitude of $(Al)(OH)^3$ depended upon the amount of $Al(OH)\chi$ precipitated and the time of reaction. X-ray diffraction of the samples showed that in the early stages of the reactions, the $Al(OH)\chi$ precipitate was present in the interlamellar space of montmorillonite lattice. In time, the interlayer material disappeared. A stable crystalline basic aluminum sulfate was formed as the interlayer Al(OH) disappeared.—J.W.H.

10403 **Skehan, James W.** Continental-oceanic boundaries of Earth and their relevance to tectonic speculations about the Moon and the planets, *in* Planetology and space mission planning—Sec. 1, Environments: New York Acad. Sci. Annals, v. 140, art. 1, p. 107–113, illus., 1966.

Studies of crustal structure in the Pacific Northwest section of the United States suggest that the Olympic-Wallowa lineament marks a boundary between continental and oceanic crust during the early Cenozoic, with Mesozoic granites to the north and basaltic crust at shallow depths to the south. The development of granitic batholiths in the Cascades and Coast Ranges suggests that continental crust has been generated in terrain formerly oceanic. It is concluded that these plutons represent older deeply buried sediments radioactively heated. Relationships of continental and oceanic crustal development along the eastern margin of the continent are analogous. Field evidence substantiates growth of the continent outward in both areas. The most striking difference between the Earth, Moon and

Mars is that the last two have no fold mountains, probably due to insufficient radiogenic heat sources.—E.S.L.

Skvarla, John J. *See* Wilson, L. R. 00502

00342 **Slack, Keith V.** Physical and chemical description of Birch Creek, a travertine depositing stream, Inyo County, California: U.S. Geol. Survey Prof. Paper 549-A, p. A1–A19, illus., tables, 1967.

Investigations of the environmental controls on travertine deposition in Birch Creek, a small stream in the White Mts. of eastern California, were carried out in the spring of 1961 and summer of 1962. Comparisons between these two years were of particular value because of the change in conditions in the second year when floods scoured away a 4–6 yr accumulation of travertine. Travertine is estimated to form at a maximum rate of 5–10 mm per year and occurs as isolated hummocks of calcite associated with algal colonies; abundance increases downstream. Water properties varied daily, with downstream distance, and between the two periods of study; the magnitude of daily variations in physical and chemical properties increased downstream. Separate identification of organic and inorganic factors is difficult because both are directly influenced by solar radiation.—V.S.N.

10506 **Slaughter, Bob H.** The vertebrates of the Domebo local fauna, Pleistocene of Oklahoma, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie Plains: Mus. Great Plains Contr., no. 1, p. 31–35, illus., table, 1966.

Besides the mammoth, vertebrate remains recovered from the late Pleistocene Domebo Formation at and near the Domebo site represent two species of amphibians, three reptiles including the extinct tortoise *Geochelone*, six or seven rodents, and an extinct bison. The extant species are living in the area today, except for the bog lemming *Synaptomys* with a present southern limit 200 miles to the north. The tropical genus *Geochelone* in the Domebo fauna suggests winters milder than today, lacking prolonged periods of freezing; *Synaptomys*, on the other hand, indicates somewhat cooler summers. Faunal composition suggests a shallow marsh with low vegetation, with woods and tall grass nearby in the stream valley. Ratio of complete jaws to fragmentary specimens indicates that the fossils had not washed far.—V.M.J.

10544 **Slaughter, T. H.; Laughlin, Charles P.** Records of wells and springs, chemical analyses, and selected well logs in Charles County, Maryland: Maryland Geol. Survey Water Resources Basic Data Rept. 2, 93 p., illus., tables, 1966.

Well data for Charles County was compiled from records obtained during the period 1946–63. Major water-bearing units are the Patuxent, Patapsco, Raritan, and Magothy Formations, Aquia Greensand, and the Pliocene and Pleistocene Columbia Group. A table shows age, thickness, and water-bearing properties of the geologic units (Precambrian to Quaternary). Ground water generally is of satisfactory chemical character for most uses. Chemical analyses of ground water, logs of selected wells, and records of wells and springs are tabulated. A map shows location of wells and springs.—M.C.M.

10394 **Smith, Neal J.** Geophysical activity in 1965: Geophysics, v. 31, no. 6, p. 1158–1180, illus., tables, 1966.

This report on 1965 geophysical activities in the Free World includes not only petroleum and mining, as before, but also activities for engineering purposes and groundwater exploration. Summaries are given for the whole world and by area.—D.B.V.

00519 **Sohl, Norman F.** Upper Cretaceous gastropods from the Pierre Shale at Red Bird, Wyoming: U.S. Geol. Survey Prof. Paper 393-B, p. B1–B46, illus., tables, 1967.

The Pierre Shale gastropod fauna shows a great taxonomic uniformity at most stratigraphic levels over wide areas of the western interior. Although the fauna is distinct at the specific level, at the generic level the gastropods exhibit a close

relationship to the contemporaneous faunas of the Gulf Coast. This similarity is most marked to the south in the Front Range of Colorado. At Red Bird gastropods first appear in the Mitten Black Shale Member and occur sporadically thereafter through the upper 1,700 feet of the 3,137-ft Pierre sequence. Twenty-three distinct species occur at Red Bird, two-thirds of which belong in the Streptoneura. The genus *Drepanochilus* (Aporrhaidae) is especially noteworthy as its representatives are an evolving lineage with changes primarily affecting position and nodosity of the whorl carinations.—N.F.S.

Sollie, S. *See* Andresen, A. 10411

Somayajulu, B. L. K. *See* Harrison, C. G. A. 10379

Sommers, David A. *See* McGill, George E. 00436

00394 **Sorem, Ronald K.; Gunn, Donald W.** Mineralogy of manganese deposits, Olympic Peninsula, Washington: Econ. Geology, v. 62, no. 1, p. 22–56, illus., tables, 1967.

Bementite is the principal manganese silicate and hausmannite the chief oxide mineral. The primary minerals belong to three paragenetic stages: prebementite—hibschite, rhodonite, tephroite, johannsenite, and alleghanyite; accompanying bementite—braunite, hausmannite, jacobsite, crednerite, alabandite, barite, native copper, manganiferous carbonate, and probably grossularite; and post-bementite—carbonates, quartz, and inesite. Supergene minerals include nsutite, todorokite, birnessite, ranceite, and neotocite. Microscopic features and concordant relationship to marine sedimentary host rocks suggest that the manganese is a primary constituent of these rocks. Submarine vulcanism may have been associated with sedimentation.—W.S.W.

00403 **Sorem, Ronald K.** Manganese nodules—Nature and significance of internal structure: Econ. Geology, v. 62, no. 1, p. 141–147, illus., 1967.

Polished sections of manganese nodules reveal variations in the composition and texture of layers, inclusions of foreign material along certain horizons, and unconformable relationships between groups of layers. These features "have a direct bearing on problems of nodule formation such as rate, mechanism, and environment of growth, and mineralogy."—W.S.W.

Souders, Robert. *See* Berg, Joseph W., Jr. 10360

10341 **Sowers, George F.; Hedges, Charles S.** Dynamic cone for shallow in-situ penetration testing, *in* Vane shear and cone penetration resistance testing of in-situ soils—ASTM Pacific Area Natl. Mtg., 5th, Seattle, Wash., 1965, Symposium: Am. Soc. Testing and Materials Spec. Tech. Pub. 399, p. 29–38, illus., 1966.

Field calibration of a portable dynamic cone penetrometer was made to determine a penetration resistance relationship with the standard penetration resistance. The penetrometer has been found useful in the inspection of footing foundations and for light field exploration where the standard penetration range of limits is generally known. The test data show that it is capable of approximating the standard penetration resistance for the virgin soils of the southeastern United States. Authors' abstract

10396 **Spector, A.; Bhattacharyya, B. K.** Energy density spectrum and autocorrelation function of anomalies due to simple magnetic models: Geophys. Prosp. [Netherlands], v. 14, no. 3, p. 243–254, illus., 1966.

Formulas of the energy spectrum and autocorrelation function have been derived for magnetic anomalies due to four classes of bodies which can be represented in turn by (1) poles, (2) line of poles, (3) dipoles, and (4) line of dipoles. The effects of the depth and dimensions of the magnetized sources on the spectrum and the autocorrelation function have been studied. In the case of the dipole models, the orientation of the polarization vector casts a significant influence on the characteristics of the two functions. In all cases, however, the functions change

in size and shape as the inclination and declination of the geomagnetic vector are varied.—Authors' abstract

00622 **Sprinkle, James; Gutschick, R. C.** *Costatoblastus*, a channel fill blastoid from the Sappington Formation of Montana: Jour. Paleontology, v. 41, no. 2, p. 385–402, illus., table, 1967.

Numerous well preserved specimens of the blastoid *Costatoblastus sappingtonensis*, n. gen., n. sp., were found within a small channel fill system in unit G of the Sappington Formation (Devonian–Mississippian) at a single locality in southwestern Montana. This new genus is characterized by having five paired spiracles, two anal deltoids, a rounded-biconical shape, and strong riblike ornamentation. The blastoids are thought to be of earliest Mississippian age.—*from* Authors' abstract

10431 **Srivastava, S. P.** Theory of the magnetotelluric method for a spherical conductor: Royal Astron. Soc. Geophys. Jour., v. 11, no. 4, p. 373–387, illus., 1966.

Impedance relations for various conductivity distributions are derived, considering the Earth to be a nonuniform spherical conductor, in a form that can be used for any number of layers of different conductivity distribution. It is shown theoretically that for small periods the impedance relations derived for a nonuniform spherical conductor are the same as those for a semi-infinite conductor with plane boundaries. It is shown that for conductivities of 0.01 and 0.001 $ohm^{-1}m^{-1}$ and periods less than a day, the effect of the Earth's curvature can be neglected when determining conductivity distribution by the magnetotelluric method.—D.B.V.

Stager, John K. *See* Mackay, J. Ross, 10586

00371 **Stanley, Daniel J.; Rhoad, Donald C.** Dune sands examined by infrared photography: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 3, pt. 1, p. 424–430, illus., 1967.

For study of primary sedimentary and biogenic structures in homogeneous coastal dune sands by infrared photography, undisturbed core samples are cemented by saturating with water and freezing. Slices, 4.5–7.0 mm thick, of the core are placed over a light source and photographed with infrared sensitive film. The abundance of sedimentary and biogenic features (burrows, plant remains, and the like) revealed in the samples photographed for this study indicates that coastal dune deposits are far from homogeneous, structureless, or organically sterile. Such studies can distinguish between humid and arid environments of dune deposition.—V.S.N.

10510 **Stanley, E. A.** The problem of reworked pollen and spores in marine sediments: Marine Geology, v. 4, no. 6, p. 397–408, illus., 1966.

Examination of plant microfossils recovered from Quaternary ocean bottom-core samples, reveals that morphologically distinct Tertiary and older pollen and spores accept Safranin O stain differently than do most of the Pleistocene or younger plant microfossils in the same assemblage. Variations in stain acceptance may reflect exine-chemistry changes that took place during the reworking process. High percentages of reworked pollen and spores in sediments formed during periods of continental glaciation are considered the result of increased erosion after base-level lowering. Large numbers in Pleistocene and much older sediments may indicate decreasing base levels associated with orogenic movements or former continental glaciations. Secondary plant microfossils can offer clues to source areas of marine sediments.—G.D.C.

10633 **Stark, Philip H.** Stratigraphy and environment of deposition of the Atoka Formation in the central Ouachita Mountains, Oklahoma, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 164–176, illus., 1966.

In the central Ouachitas the Atoka Formation was deposited in a moderately deep geosynclinal trough, first along marginal slopes, then in an upper slope to bathyal environment, where coarse clastics swept in by normal marine currents and turbidity flows were deposited as sandy flysch. Differential subsidence to the north is

indicated in the Windingstair Range by limited clastic influx in a deep reducing basin. In the Kiamichi Range where the shale facies, defined by lower sand/shale ratio, closely resembles the underlying sandstone facies, the trough remained moderately deep with continuous coarse influx. The deep-basin reducing environment explains erratic Foraminifera distribution, abundant siliceous sponges and Radiolaria, and the repetitious sequence of fine-grained turbidite sandstones and black pyritiferous shales.—G.D.C.

10597 **Stauder, William; Bollinger, G. A.** The S wave project for focal mechanism studies—The Alaska earthquake sequence of 1964—AFCRL Contract AF 19(628)-5100, Sci. Rept. 1 (AFCRL-66-572): Bedford, Mass., U.S. Air Force Cambridge Research Labs., Office Aerospace Research, 124 p., illus., tables, 1966.

Focal mechanisms were determined for one pre-shock, the main shock, and over 25 aftershocks of the Alaska earthquake of March 28, 1964. Polarity of the P-wave first motion in the main shock yields a single nodal plane, with strike N. 66° E. and dip 85° southeastward; it may be taken either as normal to the motion or as the fault plane. In the Kodiak Island region a single steep plane of related earthquakes is oriented as that of the main shock. East of Prince William Sound a systematic change in orientation of the vertical nodal plane of P corresponds to the change in trend of tectonic features. By S-wave data, the second nodal plane is found to dip north about 10°, inferring the same orientation as the first nodal plane. Hypocenters north of the Sound increase in depth along lines of greatest flexure of the tectonic features; this may be a clue to the main shock motion.—G.D.C.

10552 **Stauft, D. L.** Computer well-data systems—A company case history: Jour. Canadian Petroleum Technology, v. 5, no. 4, p. 165-170, illus., 1966.

The computer-based well-data system with data stored on magnetic tape, developed by Imperial Oil Limited in 1958, is described from the point of view of a user. The system up to 1963 had stored basic data and geological tapes on each of 37,000 wells drilled to that time in western Canada. Data on the 7,000 wells drilled since are being added. It is emphasized that for such a system to be successful, users must take an active role in design, development, and operation, and that only basic factual data should be recorded. The cost of the system is difficult to evaluate since the worth of technical time is more important than unit costs.—V.S.N.

00460 **Stearns, Harold T.; Chamberlain, Theodore K.** Deep cores of Oahu, Hawaii and their bearing on the geologic history of the Central Pacific Basin: Pacific Sci., v. 21, no. 2, p. 153-165, illus., tables, 1967.

In drilling to recover complete core sections in the Ewa Coastal Plain near Pearl Harbor, the first hole 200 yards inland from the beach penetrated the basaltic core of Oahu beneath 1,072 feet of interbedded coral reefs, lagoonal muds, sands, and soils. In the second hole, 2 miles inland on the same meridian, 517 feet of sedimentary rocks were penetrated before basement basalts were encountered. More than 85 percent of the core was recovered in both holes. These two cores were used to reinterpret logs from a number of wells that had been drilled without saving samples. Lithologic types encountered are described: alternate flows of pahoehoe and aa basalt appear in the lower portion of each core. A preliminary geologic history of the Ewa Coastal Plain suggests shifting of the coral reef behind which the lagoonal deposits accumulated.—G.D.C.

10600 **Stearns, Harold T.; Anderson, Alfred L.** Geology of the Oxbow on Snake River near Homestead, Oregon: Idaho Bur. Mines and Geology Pamph. 136, 23 p., illus., geol. map, 1966.

The Oxbow, site of a new dam and powerplant on the Idaho–Oregon line, is set in a deep canyon in the Columbia River Plateau, carved in the Permian Seven Devils Volcanics, overlain by flows and pyroclastics of Miocene Columbia River basalt. The Seven Devils Volcanics in this area are chiefly andesitic and rhyolitic flows and pyroclastics, with a local schist-gneiss unit. They were folded and faulted during late Jurassic(?), and locally appear to be in a compressed syncline. The oxbow

loop apparently was guided by a large northeast-trending post-basalt fault and northeast structures in the older rocks.—*from* Authors' abstract

10480 **Stehli, Francis G.** Labyrinthodont abundance and diversity [discussion of paper by E. Irving and D. A. Brown, 1964]: Am. Jour. Sci., v. 264, no. 6, p. 481–487, illus., 1966.

Irving and Brown (ibid., v. 262, p. 689–708, 1964) have attempted to treat the abundance and diversity of labyrinthodont amphibians as a function of paleomagnetic latitude. Their conclusions are examined in terms of two questions: Is there a simple latitude dependence in the "Abundance and Diversity" parameter used by Irving and Brown? Is it possible by return to the untreated data to extract sufficient valid labyrinthodont diversity data to determine whether it better fits a paleomagnetic or a present-day latitude framework? The answer to both these questions is negative.

10445 **Steiger, Rudolf H.; Wasserburg, G. J.** Systematics in the Pb^{208}–Th^{232}, Pb^{207}–U^{235}, and Pb^{206}–U^{238} systems: Jour. Geophys. Research, v. 71, no. 24, p. 6065–6090, illus., tables, 1966.

Pb-208/Th-232 and Pb-207/U-235 ratios in cogenetic zircons form a linear array in the corresponding Pb–U–Th evolution diagram, intersecting the concordia curve at the same point determined by the Pb-206/U-238, Pb-207/U-235 array. U and Th contents and Th/U ratios vary even within single crystals. Variability of the Th/U ratio is of fundamental importance in understanding the evolution of the Th–U–Pb system. The systematics discussed here may provide an additional independent dating system, and a further means of studying transport from natural systems.—D.B.V.

10646 **Sterling, Philip J.; Stone, Charles G.; Holbrook, Drew F.** General geology of eastern Ouachita Mountains, Arkansas, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 177–194, illus., table, 1966.

This eastern core area of the Ouachita Mts. consists of intensely folded sedimentary rocks of Paleozoic age. Exposed formations are briefly described herein, from Balkely Sandstone to Stanley Shale. The rocks, in recumbent north-dipping folds, show low-grade metamorphism from Pennsylvanian orogeny. Epithermal quartz veins are common and generally larger in northern parts; most of them are related to late stages of this deformation. A sill-like Paleozoic intrusion is being mined for soapstone in the northern core area; small dikes, sills, and pipes of Cretceous age are common near Benton. A few industrial minerals and many abandoned metal prospects and slate are known in the area.—G.D.C.

00611 **Stevens, Calvin H.** Leonardian (Permian) compound corals of Nevada: Jour. Paleontology, v. 41, no. 2, p. 423–431, illus., 1967.

Leonardian (Permian) compound corals are found in moderate to great abundance in an arcuate band that extends across White Pine and Elko Counties, eastern Nevada. Four genera have been recognized: *Durhamina* Wilson and Langenheim and *Orionastraea* Smith are each represented by one species; *Kleopatrina* McCutcheon and Wilson is represented by three species; and *Heritschioides* Yabe by five species. Two new species of *Kleopatrina, K. nevadaensis and K. arcturusensis,* and three new species of *Heritschioides, H. buttensis, H. moormanensis and H. parvum,* are described. *Heritschioides* is subdivided into two subgenera, *H. (Heritschioides)* Yabe and *H. (Eoheritschioides)* n. subgen., which are thought to have different stratigraphic ranges. Several corals are narrowly restricted in time and therefore are useful in correlation.—Author's abstract

00529 **Stewart, Gary F.** Jointing in Upper Pennsylvanian limestones in northeastern Kansas, *in* Short papers on research in 1966: Kansas Geol. Survey Bull. 187, pt. 1, p. 17–19, illus., 1967.

Joint sets were examined in the Plattsmouth and Leavenworth limestone members of the Oread Limestone and in the Ervine Creek and Rock Bluff limestone members

of the Deer Creek Limestone. These joint sets trend about N. 60° E. and N. 35° W., respectively. The long, planar northeast-trending shear joints are more common than the short, rough-surfaced northwest-trending tension joints. Short, planar north-trending joints also are present in these beds.—Author's abstract

Stiles, Newell T. *See* Rucker, James B. 00445

10490 **Stokes, William Lee; Anderson, Megan; Madsen, James H., Jr.** Fossil and subfossil bison of Utah and southern Idaho: Utah Acad. Sci., Arts and Letters Proc., v. 43, pt. 2, p. 37–39, 1966.

A number of skulls have been accumulated and preserved in collections of the Department of Geology, University of Utah. Three Pleistocene specimens are described: *Bison latifrons* from the Rupert area, Idaho, and *B. antiquus* from the Kearns and Silver Creek Junction areas, Utah. All others are less than 10,000 years old.—E.S.L.

10634 **Stone, Charles G.** General geology of the eastern frontal Ouachita Mountains and southeastern Arkansas Valley, Arkansas, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 195–221, illus., table, 1966.

The frontal Ouachitas here comprise an east-west trending belt about 15 miles wide, with steep, narrow, commonly overturned folds, some chaotic structure and major thrust faults; Stanley Shale and Jackfork Sandstone are exposed, except east of the Fall Line. The transition zone on the north has simpler structures crossed by several major thrust faults; at the surface here and also in the Arkansas Valley folded area Atoka sandstones and shales are exposed. Hartshorne Sandstone and McAlester Shale, both Pennsylvanian, are preserved in synclines. Pleistocene terrace deposits and Recent alluvium occur along the Arkansas River and some smaller streams. There are a few igneous dikes, sills, and volcanic breccias of Cretaceous(?) age, and numerous older quartz veins in the southern part.—G.D.C.

Stone, Charles G. *See* Sterling, Philip J. 10646

00494 **Stott, D. F.** The Cretaceous Smoky Group, Rocky Mountain Foothills, Alberta and British Columbia [with French summ.]: Canada Geol. Survey Bull. 132, 133 p., illus., tables, geol. map, 1967.

Marine sandstones and shales of the Smoky Group, originally described in the Peace River Plains, extend into the Foothills of northeastern British Columbia and northern Alberta. Lithology, palaeontological data, and palaeogeography are discussed. The Kaskapou Formation thickens westward from the type region and grades laterally into epineritic sandstones. The Cardium Formation persists along the Foothills but grades eastward into shale. The Muskiki Formation is overlain by early Santonian regressive deposits included in the Bad Heart Formation. The Puskwaskau Formation includes another major transgressive-regressive sequence of Santonian to possibly Campanian age. [Selected sections, faunal lists, and correlation are presented.]—Author's abstract

10438 **Strahler, Arthur N.** A geologist's view of Cape Cod: Garden City, N. Y., Nat. History Press (for Am. Mus. Nat. History), 115 p., illus., 1966.

The book is divided into seven sections. The first describes how the Cape was formed of till deposited during a long standstill of the ice margin rather late in the Wisconsin stage of the Pleistocene. This includes the east-west moraines and outwash plains, with their lakes and ponds. The moraine along the east shore appears to have been eroded away. Work of the waves comprises the second section, and includes the marine scarps, rate of retreat along the east shore (about 3 feet per yr), hanging valleys, sand bars and spits, and the growth of Provinceland. The third section, on tides, covers the origin of salt marshes. Ponds and bogs occupying kettles, and their relation to ground water and salt water are discussed in the fourth section. The fifth covers wind work, mostly dunes. Two short sections on soils and a discussion on the geologic future of the Cape conclude the book.—E.S.L.

10660 **Straley, H. W., 3d.** Magnetic anomalies and epicentral lines on the South Carolina coastal plain: Tectonophysics, v. 3, no. 5, p. 375–381, illus., 1966.

The history of magnetic geophysical investigations upon the southern Atlantic Coastal Plain is traced, an incomplete map of part of South Carolina is presented, and a few hypothetical geological structures or lithological alignments [features parallel or transverse to Appalachian trends] that may be reflected in the plotted magnetic data are pointed out.—Author's abstract

10587 **Straw, Allan.** Periglacial mass movement on the Niagara Escarpment near Meaford, Grey County, Ontario: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 8, no. 4, p. 369–376, illus., 1966.

Two sections made along the road through the Niagara Escarpment south of Meaford show that, at some earlier period, blocks of Middle Silurian dolomite have been subjected to mass movements which caused widening of their joints and the displacement of the blocks themselves over underlying Lower Silurian shales. The upper layers of these shales have been grossly disturbed by frost action, and the occurrence of solifluction debris around the blocks and in some of the joints is taken as additional evidence of mass movement during a periglacial period. Comparison is made with similar frost-induced mass movement in England and it is suggested that the Niagara Escarpment features may have been produced during the Valders substage of the late Wisconsinan glaciation.—Author's abstract

00385 **Stringham, Bronson.** Hydrothermal alteration near the Horn Silver mine, Beaver County, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 16, 35 p., illus., table, geol. maps, 1967.

The Horn Silver orebody, one of the most productive lead–silver deposits in Utah, was formed along the Horn Silver fault where Upper Cambrian limestones and dolomites are in fault contact with Ely Limestone. East of the fault is the following volcanic sequence: Needles Range Formation overlain by Horn Silver Andesite, Ison Formation ignimbrite, a gray basalt, and a Quichapa ignimbrite. Quartz latite porphyry flows lie unconformably on most of the other volcanic units. Both sedimentary and volcanic rocks are transected by intrusions of quartz monzonite followed closely by quartz monzonite porphyry; there are numerous breccia pipes, especially in the Horn Silver Andesite. Alteration stages are propylitization, hematitization, silicification, alunitization, argillization and pyritization.—G.D.C.

10366 **Stueber, Alan M.; Murthy, V. Rama.** Strontium isotope and alkali element abundances in ultramafic rocks: Geochim. et. Cosmochim. Acta, v. 30, no. 12, p. 1243–1259, illus., tables, 1966.

The concentrations of Na, K, Rb, and Sr and the Sr isotopic composition have been measured in a suite of 30 ultramafic rocks of different types of occurrence. The results indicate that alpine-type ultramafic rocks are not related to the ultramafic zones of normal stratiform sheets nor to basalts, nor do they result from crystal accumulation of mafic magmas, but could be derived from a hypothetical peridotite substratum. Basalt could be derived from partial fusion of garnet peridotite material (represented by ultramafic inclusions in kimberlite pipes), but not from either alpine-type ultramafic material or from the ultramafic inclusions found in basalts.—D.B.V.

Stuiver, Minze. *See* Denton, George H. 10463

Swain, Frederick M. *See* McKenzie, K. G. 00390

00391 **Swain, Frederick M.; Gilby, J. M.** Recent Ostracoda from Corinto Bay, western Nicaragua, and their relationship to some other assemblages of the Pacific Coast: Jour. Paleontology, v. 41, no. 2, p. 306–334, illus., 1967.

The Ostracoda from Corinto Bay comprise 37 species, of which seven are new. The new species are *Pumilocytheridea realejoensis, Caudites acosaguensis, Mutilus cardonensis, Cytheromorpha limonensis, Paracytheroma hartmanni, Basslerites punctofissurella, and Loxoconcha? magnipustulosa.* The bay is a lagoonal complex

up to 25 m deep and has mainly a euhaline environment. The outer bay sediments are volcanic and consist of silty, ashy, and clayey sands and sandy silts. The Corinto Bay ostracode assemblage, like those of other localities studied along the north Pacific coast and near Central America, consists by more than half of species ubiquitous to the entire coastal area. Like other assemblages studied, however, it contains 20 to 25 percent of seemingly indigenous species. The indigenous species evidently developed in the absence of barriers other than those of climatic nature.—*from* Authors' abstract

Swain, Frederick M. *See* Dickinson, Kendell A. 00621

10401 **Swindale, L. D.; Uehara, G.** Ionic relationships in the pedogenesis of Hawaiian soils: Soil Sci. Soc. America Proc., v. 30, no. 6, p. 726–730, illus., table, 1966.

Direct relationships exist between the amount of pedogenic mica in Hawaiian soils and (1) the amount of exchangeable potassium per unit of base saturation and (2) the concentration of potassium in the soil solution. The parameters, log $[K^+]/[H^+]$ and log $[H_4SiO_4]$, which are derived from the mass action equations for mica, kaolin, and gibbsite, when measured for soil solutions, are useful indicators of mineral stabilities in these soils. Tests of physical models of the chemical systems involved show that pedogenic mica is not now in equilibrium with its environment.—Editor's brief

00430 **Symons, D. T. A.** A paleomagnetic study of concentrating iron ores from northern Michigan: Econ. Geology, v. 62, no. 1, p. 118–137, illus., tables, 1967.

Results suggest that primary remanence directions, acquired at the time the oxide-facies iron formation was deposited as sediment, have been strongly modified during metamorphism. Primary remanence directions have apparently been rotated into the bedding plane. The rotation mechanism is not clear, but may be due more to stress than to thermal effects during the metamorphism. Paleomagnetic pole positions for Keweenawan diorite and Cambrian sandstone are thought to be fairly reliable.—W.S.W.

10405 **Szasz, S. E.** Adaptation of well logging methods to planetary exploration, *in* Planetology and space mission planning—Sec. 2, Signatures: New York Acad. Sci. Annals, v. 140, art. 1, p. 281–293, 1966.

Logging methods that might be adaptable to planetary exploration are described. The electrical methods include potential and resistivity; nuclear methods, gamma ray, gamma–gamma, and neutron, the last divided into hydrogen and chlorine logs, and detection of other elements; and finally acoustic measurements. The hypothesis is presented that capture of the Moon and post-Precambrian evolution of the Earth are related.—E.S.L.

10339 **Takasaki, K. J.; Valenciano, Santos; Ho, A. M.** Preliminary report on the water resources of the Kahuku area, Oahu, Hawaii: Hawaii Div. Water and Land Devel. Circ. C39, 33 p., illus., tables, 1966.

The Kahuku area, 61 sq mi in the northeastern part of the Koolau Range, is underlain by basaltic lava flows and dikes which strike parallel to the range, and some sedimentary material in the lowlands. Rainfall ranges from 300 in on the crest to 30 in on the lowland. Most streams are ephemeral in the lower reaches. Ground water is compounded by dikes in a 2–3 mi wide zone along the crest, and contributes to flow in the middle reaches of streams whose valleys are deep enough to intersect it. In coastal areas, dike-free lava flows contain water, and the sedimentary material contains minor amounts. Supplies in each of the four subareas are discussed and fluctuation graphs given. Chloride content near the coast is increasing slightly.—E.S.L.

Takenouchi, S. *See* Kitahara, S. 10373

00313 **Tasch, Paul.** Conchostracans from the Lower Cretaceous (Albian) Paluxy Formation, Texas: Jour. Paleontology, v. 41, no. 1, p. 256–259, illus., 1967.

This is the first report of a Cretaceous conchostracan in North America. They lived in brackish or fresh water, each surviving for one to two and a half months.—R.E.G.

10569 **Taylor, Donald M.** Project Mohole, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. FF1-FF2, 1966.

The need for greater knowledge of the mantle, and the successful completion of Phase I and progress on Phase II of Project Mohole are reviewed.—E.S.L.

Taylor, P. T. *See* Lee, W. H. K. 10382

Teichert, Curt. *See* Rhodes, F. H. T. 10471

00421 **Tennessee Division of Geology.** Status of detailed geologic mapping in Tennessee, January 1, 1967: Nashville, Tenn., Tennessee Div. Geology, 1 sheet, 1967.

10665 **Terasmae, J.; Webber, P. J.; Andrews, J. T.** A study in late-Quaternary plant-bearing beds in north-central Baffin Island, Canada [with French and Russian abs.]: Arctic, v. 19, no. 4, p. 296-318, illus., tables, 1966.

Buried plant-bearing beds along Isortoq River at the northern end of Barnes Ice Cap on Baffin Island have been [C-14] dated at more than 38,830 and 40,000 years B.P. A palynological and palaeobotanical study has indicated the presence of species (e.g. dwarf birch) which now occur several hundred kilometres south of this locality. Because of the inferred climatic conditions, more favourable than the present, an interglacial age (Sangamon) is assigned to the Isortoq plant-bearing beds. Folding of the Isortoq beds by overriding ice and the orientation of the overturned folds indicate accumulation of the initial ice cap east of this locality.—Authors' abstract

10524 **Terry, Richard D.** Continental slopes of the world [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 65, 1966.

Theokritoff, George. *See* Rasetti, Franco. 00531

Thiruvathukal, John V. *See* Berg, Joseph W., Jr. 10360

Thompson, Gary G. *See* Cross, Aureal T. 10509

Thornburn, T. H. *See* Liu, T. K. 10399

Thrasher, J. E. *See* Schoeppel, R. J. 10562

Thyer, J. R. *See* Holuj, F. 10650

00568 **Tillman, C. G.** *Triamara cutleri*, a new cystoid from the Osgood Formation (Silurian) of Indiana: Jour. Paleontology, v. 41, no. 1, p. 222-226, illus., 1967.

Triamara cutleri, n. gen., n. sp., is a diplopore-bearing stemless cystoid characterized by three unequally long, deeply impressed ambulacral grooves arranged in the form of a Y. An opening, inferred to be the peristome, is present several millimeters along the longest groove from the point of intersection of the three grooves. Each of the three arm bases appears to have borne two brachioles.—Author's abstract

00513 **Tomikel, John.** An indoor stratigraphy exercise: Jour. Geol. Education, v. 15, no. 1, p. 18, 1967.

The proposed exercise may be used in many schools instead of a field trip to climax geologic training, if conditions do not permit a trip. Samples of the strata in the field trip area should be accumulated and placed on movable shelves in the order in which they appear, dip indicated by tilting, and distance between shelves representing the thickness. Geographic locations should be listed by each column, and topographic maps given to the students, who should be able to identify

structures and make correlations. However, for an overall view there is no substitute for field work.—E.S.L.

10365 **Tomikel, John.** Physical geology—Lab manual and note book: Minneapolis, Minn., Burgess Publishing Co., 69 p., illus., 1966.

Work sheets for 18 laboratory sessions include mineral identification, rocks, topographic map studies, dip and strike, geologic map interpretation, fence diagrams, geologic structure studies, sedimentary deposits and their history, analysis of stream patterns, and four quadrangle studies, including Mt. Rainier, Wash., Whitewater, Wisc., Mammoth Cave, Ky., and Bright Angel, Ariz. Six extra exercises are included.—E.S.L.

Tomlinson, R. H. *See* McMullen, C. C. 10649

Toots, Heinrich. *See* Houston, R. S. 10623

10511 **Traverse, Alfred; Ginsburg, Robert N.** Palynology of the surface sediments of Great Bahama Bank, as related to water movement and sedimentation: Marine Geology, v. 4, no. 6, p. 417–459, illus., tables, 1966.

From a series of traverses on the Great Bank and from other locations about 130 sediment samples were analyzed for fossil pollen and other microfossils. Pine pollen is especially significant due to its buoyancy, by which it remains suspended in water for long periods and shows an apparent inverse relation to its distribution in the sediments. Microforaminiferal chitinous inner tests are found in abundance in some sediment stations where pollen highs are not found. Originally calcareous and typically bottom dwellers, foraminifers tend to be deposited in situ. Charts show distribution of pine and other pollen, microforaminiferal tests, hystrichosphaerids, and HCl-insoluble organic residues. Maceration-resistant microfossils in ancient carbonate banks may be a clue to water movements and sedimentation.—G.D.C.

Trembly, Lynn. *See* Berg, Joseph W., Jr. 10360

Treves, S. B. *See* Bayley, R. W. 10407

Tu, H. Y. *See* Barrows, H. L. 10435

10656 **Tubey, L. W.; Beaven, P. J.** A study of the petrology of some soft limestones from Jamaica in relation to their engineering properties: Harmondsworth Road Research Lab. RRI Rept. 21, 37 p., illus., tables, 1966.

The petrologic characteristics of soft limestones, mainly from Jamaica, were studied in thin sections cut from specimens impregnated with dyed resin. Laboratory tests show that the proportion of voids has a two-fold influence on strength; strength increases as void-content decreases and as the proportion of voids filled with calcitic cement increases. Voids are affected by the type and proportion of fossils. In general, a higher degree of correlation between petrologic and engineering properties occurs for the soft limestones than for harder roadstones. Petrologic examination could usefully be extended to other soft limestones to improve understanding of their engineering behavior.—*from* Authors' abstract

10419 **Turnock, A. C.** Synthetic wodginite, tapiolite, and tantalite: Canadian Mineralogist, v. 8, pt. 4, p. 461–470, illus., table, 1966.

Synthesis, phase relations, and physical properties of solid phases in the systems tantalite-tapiolite-oxygen and tantalite-$FeTaO_4$ are described. In pegmatitic magma enriched in Ta, Fe, and Mn, the occurrence of one or more of the minerals tantalite, tapiolite, and wodginite and their ferrous-ferric ratios are controlled by the partial pressure of oxygen.—B.C.H.

Uehara, G. *See* Swindale, L. D. 10401

10501 **Upson, Joseph E.** Salt-water encroachment problems of coastal aquifers with special reference to northwestern Europe and northeastern United States, *in* Am.

Water Resources Conf., 2d Ann., Chicago, 1966, Proc.: Am. Water Resources Assoc. Proc. Ser., no. 2, p. 38–46, illus., 1966.

In the Netherlands region salty water extends far inland in glacial deposits, and thin sheets and discrete bodies of fresh ground water extend into salt water beneath high coastal sand dunes. The Chalk of Denmark and England contains salty water probably unrelated to the present sea. In northeastern United States, in older formations between Maryland and New Jersey, salty water occurs many miles inland and fresh water extends substantial distances out to sea; at some coastal spots a single well may penetrate alternating lenses. Along the Atlantic Coast are no dunes comparable to those of the Netherlands, but many miles of narrow barrier beaches in which lenses of fresh water surrounded by sea water are replenished by rainfall; some deeper confined aquifers are recharged by underground flow from land. G.D.C.

00497 **U.S. Bureau of Mines.** Production potential of known gold deposits in the United States: U.S. Bur. Mines Inf. Circ. 8331, 24 p., illus., tables, 1967.

The 1,300 lode and placer deposits which include most of the significant gold reserves in the United States are estimated to contain 400 million ounces of gold. Only 9 million ounces, of which nearly 96 percent is in producing lode mines in Nevada and South Dakota, could be mined at 35 dollars per ounce with prevailing mining and metallurgical techniques. Significant increase in available gold, barring an increase in price, will depend either on discovery of new sources, intensive exploration in the most promising known mineralized areas, or development of new technology.—C.S.B.

10433 **U.S. Geological Survey.** Geological Survey research 1966, Chap. A: U.S. Geol. Survey Prof. Paper 550–A, p. A1–A385, illus., 1966.

This volume summarizes results of investigations during 1966 of natural resources, geology and hydrology applied to engineering and public health, regional geology, countries other than U.S., principles and processes, and topographic surveys and mapping. Additional information includes publications program, cooperators during fiscal year 1966, Geological Survey offices, investigations in progress in Geologic, Water Resources, and Conservation Divisions, contents of chapters B, C, and D of Geological Survey research 1966, publications by Survey authors, and indexes.—M.C.M.

Valenciano, Santos. *See* Takasaki, K. J. 10339

00610 **Valentine, J. W.; Peddicord, R. G.** Evaluation of fossil assemblages by cluster analysis: Jour. Paleontology, v. 41, no. 2, p. 502–507, illus., 1967.

Cluster analysis is used to group 66 fossil collections containing 246 species of mollusks from the California marine Pleistocene. An unweighted coefficient of Fager ($FC = C/\sqrt{(ab)} - 1/2\sqrt{\min(a,b)}$) is used for relating samples where a and b are the numbers of species contained in collections A and B, C is the number of species in common between samples A and B, and min (a,b) is the smaller of the values of a or b. Clustering is done by a modification of the weighted pair group method of Sokal and SNEATH. Major factors interpreted as affecting the clustering of the collections include: major facies represented (in this case rocky shores); geographic location; and relative contribution of special habitats.—J.F.M.

00478 **VanSchmus, W. R.; Koffman, D. M.** Equilibration temperatures of iron and magnesium in chondritic meteorites: Science, v. 155, no. 3765, p. 1009–1011, illus., table, 1967.

The distribution coefficients for Fe^{++} and Mg^{++} were calculated from new microprobe analyses of coexisting olivine, orthopyroxene, and calcic pyroxene in chondritic meteorites. Interpretation of the data shows that (1) the equilibration temperatures were of the order of 850°C, and (2) the olivine–orthopyroxene partition does not reflect ideal behavior. This equilibration temperature is much lower than previous estimates.—Authors' abstract

VanSickle, Gordon H. *See* Gott, Garland B., Jr. 00454

VanWeele, B. *See* Herbich, John B. 10580

00323 **Vaughn, Peter Paul.** Evidence of ossified vertebrae in actinopterygian fish of early Permian age, from southeastern Utah: Jour. Paleontology, v. 41, no. 1, p. 151–160, illus., 1967.

Vertebral centra, about a millimeter high, were found in what appear to be transitional beds between Wolfcampian marine carbonates and the redbeds of the Cutler Group. They are of quadripartite structure; each consists of a calcified "notochordal plug", an hourglass of dense bone, a collar of spongy bone, and unossified arch bases. They most closely resemble the centra of the amiiform holosteans, including the living *Amia*. This structure is of a degree of advancement heretofore unsuspected for early Permian time.—*from* Author's abstract

10635 **Viele, George W.** Fabric analysis of folded sedimentary rocks, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 222–244, illus., 1966.

For structural geologists a simple and useful tool is the stereographic net. Essentially it is a three dimensional protractor permitting easy calculation of the attitudes of fold axes and axial planes, these elements completely defining the geometry of a fold. Examples are given of the calculations. To discern regional tectonic styles, fabric diagrams of poles to bedding planes and synoptic diagrams of fold axes and axial planes are a valuable supplement to geologic mapping. Examples are given from areas of complex structure in the Ouachita Mountains of Arkansas.—Author's abstract

10636 **Viele, George W.** The regional structure of the Ouachita Mountains of Arkansas, a hypothesis, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 245–278, illus., geol. map, 1966.

For this region a broad arched nappe or series of nappes is suggested; of which the Little Rock salient is a strongly digital limb. From southwest to northeast, all planar elements rotate from horizontal to northeast dipping attitudes. Recumbent folds, isoclinal near Benton, occur as far west as Ida, Ark., where a thrust overrides them. On the northeast edge of the Ouachitas is a glide plane for a series of landslides of detached Carboniferous sediments. Flattening in the decollement zone accounts for displacement of thrust faults rooted north of the Benton–Broken Bow uplift; those south of the uplift may be back limb shears or foreland of a coastal plain nappe. Two tectonic models are suggested: an Ouachita core carrying and folding a suprastructure of Carboniferous sediments, and a basement uplift causing northward sliding of lower Paleozoic strata, then of Carboniferous sediments.—G.D.C.

00431 **Voight, Barry.** On photoelastic techniques, *in situ* stress and strain measurement, and the field geologist: Jour. Geology, v. 75, no. 1, p. 46–58, illus., 1967.

Determination of stress in rocks in the field is feasible by use of photoelastic strain gages. The biaxial strain gage consists of a polished disk of optical strain-sensitive material with a central hole. The disk is cemented to the surface of a rock under stress and then removed by overcoring. The resulting strain in the disk may be analyzed in polarized light and translated into terms of original shear intensities and directions. The uniaxial strain gage consists of a rectangular pre-stressed plate of epoxy and is convenient for determination of magnitudes of principal strain, once the principal directions are known.—R.E.W.

Voight, G. K. *See* Boyle, J. R. 00358

00552 **Voight, Harold.** In memoriam—Ralph Gregory Nichols (1916–1966): Houston Geol. Soc. Bull., v. 9, no. 5, p. 18, 1967.

10483 **vonHuene, Roland.** Glacial-marine geology of Nuka Bay, Alaska, and the adjacent continental shelf: Marine Geology, v. 4, no. 4, p. 291–304, illus., 1966.

Structures interpreted from continuous seismic reflection profiles indicate that the glacier which last filled Nuka Bay had a stationary terminus for a time at the fiord's present topographic sill and then receded very rapidly. Sediments deposited since this major recession are undisturbed by possible subsequent minor glacial advances. Settling of material from suspension, slumping, and local density or bottom currents have distributed sediment in closed basins of the fiord's rugged basement topography. The glacial appearance of topographic ridges on the continental shelf off the Kenai Peninsula does not result from the accumulation of glacial drift but is more likely the product of erosion, tectonism, and proglacial deposition. Some bathymetric features previously thought to show the extent of ice during the last glaciation are now believed to have been formed tectonically.—Author's summary

10529 **vonHuene, Roland; Shor, George G., Jr.** Structure of the continental to oceanic transition in the Gulf of Alaska [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 72, 1966.

Vossler, Donald A. *See* Berg, Joseph W., Jr. 10360

Waagé, Karl M. *See* Denson, Norman M. 10440

Waananen, A. O. *See* Kachadoorian, Reuben. 00355

Walker, Leland J. *See* Am. Society for Testing and Materials. 10340

Walker, R. M. *See* Huang, W. H. 00499

00437 **Walker, Theodore R.** Formation of red beds in modern and ancient deserts: Geol. Soc. America Bull., v. 78, no. 3, p. 353–368, illus., table, 1967.

From a study of Recent, Pleistocene, and Pliocene red beds deposited in fluvial and fluvial-marine transitional environments in the Sonoran desert of northeastern Baja California, it is concluded that the red beds were formed after deposition in hot arid or semiarid climates. They are associated with evaporites in an area where faunal, floral, and pedological evidence indicates a low rainfall. Both red conglomerates and red intertidal muds show that alteration of hornblende and biotite produced red hematite stained red beds. The late Paleozoic red beds of Colorado are interpreted as analogs.—R.G.Y.

10653 **Walthall, Bennie H.; Bowsher, Arthur L.** Geology of part of southern Ouachitas, Arkansas, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 125–139, illus., geol. map, 1966.

The Athens plateau, chiefly in Pike County, has the only surface exposures of the Ouachita structural province south of the Broken Bow–Benton uplift. The complexly folded and faulted Paleozoic strata are onlapped from the south by the Cretaceous Trinity Group. The stratigraphy of the underlying Mississippian-Pennsylvanian sequences (Stanley through Atoka) is summarized. Their close similarity in the frontal belt, central Ouachitas, and Athens plateau suggests one depositional basin. In the Athens plateau the sequence is much thicker with a larger proportion of detrital pebbles becoming more abundant and larger in the south-southeast pointing to that source direction. The structure in the Athens plateau is that of parallel, ruptured, recumbent anticlines with tight folds and steep fault planes, homologous with the frontal belt.—G.D.C.

Walton, W. C. *See* Ackroyd, E. A. 00458

Ward, A. E. *See* Grose, L. T. 00619

10607 **Ward, Peter; Ward, Sandra.** Volcanic activity in Katmai National Monument, in early August, 1965: Earthquake Notes, v. 37, no. 3, p. 19–34, illus., tables, 1966.

From August 3 until August 5, 1965, a heavy concentration of dust and some sulphurous fumes were noted in the Valley of 10,000 Smokes and the Brooks River area of Katmai National Monument, Alaska. Visual and seismic observations during July and August indicated that although there was no major volcanic eruption, there was a slight increase of seismic activity in late July near Mt. Trident and in early August near Mt. Martin. Observations of volcanic activity, however, in the Katmai region during 1965, were inadequate to relate volcanic and seismic events. While an aeolian origin for the observed dust and fumes cannot be ruled out, some type of volcanic activity seems likely.—Authors' abstract

Ward, Sandra. *See* Ward, Peter. 10607

Wartburg, A. F. *See* Cadle, R. D. 00433

Wasserburg, G. J. *See* Steiger, Rudolf H. 10445

00357 **Wasson, John T.; Alder, B.; Oeschger, H.** Aluminum-26 in Pacific sediment—Implications: Science, v. 155, no. 3761, p. 446–448, illus., tables, 1967.

Al-26 has been detected in a sample of sediment from the South Pacific. The disintegration rate of 0.8 dpm per kg of dry sediment is considerably higher than that expected from cosmic-spallation of atmospheric argon; it appears to result mainly from accretion of activity induced in interplanetary dust by solar-flare particles. This finding is in keeping with Wasson's published estimate regarding the magnitude of this effect, and confirms the order-of-magnitude correctness of the solar-particle flux and terrestrial accretion rate of interplanetary dust used in that calculation.—Authors' abstract

00473 **Wasson, John T.** Concentrations of Ni, Ga, and Ge in a series of Canyon Diablo and Odessa meteorite specimens: Jour. Geophys. Research, v. 72, no. 2, p. 721–730, illus., tables, 1967.

The Ni, Ga, and Ge concentrations in two samples of Odessa and six of Canyon Diablo were determined. In Canyon Diablo the range of Ni concentrations is 7.0–8.2 percent, in agreement with earlier studies; the range of Ga concentrations, 79–83 ppm, is considerably smaller than previously reported; and Ge concentrations range from 317 to 332 ppm. Concentrations of all three elements were similar in Odessa. These data and the structure of the meteorites suggest that Canyon Diablo and Odessa are members of the same genetically related Ga-Ge group but are not likely to be "paired falls." The six Canyon Diablo specimens, which include atypical No. 2 and No. 3, are all parts of the same meteoroid.—D.B.V.

Webber, P. J. *See* Terasmae, J. 10665

10421 **Weber, J. B.** Molecular structure and pH effects on the adsorption of 13 *s*-triazine compounds on montmorillonite clay: Am. Mineralogist, v. 51, nos. 11–12, p. 1657–1670, illus., tables, 1966.

The adsorption of 13 related *s*-triazine compounds on montmorillonite clay as influenced by pH and molecular structure was investigated. Adsorption isotherms for prometone on montmorillonite were determined at six pH levels. The maximum adsorption of all the compounds on montmorillonite was found to occur at a pH in the vicinity of the pK_A value of each compound. Substituent groups on the triazine ring were found to be related to the amount of adsorption which resulted. Mechanisms of adsorption were postulated and discussed.—Author's abstract

00362 **Weertman, J.** An examination of the Lliboutry theory of glacier sliding: Jour. Glaciology, v. 6, no. 46, p. 489–494, 1967.

An examination is made of the Lliboutry theory of glacier sliding. It is concluded that this theory is incompletely developed and therefore it is impossible at present to make meaningful predictions of the sliding velocity from it that might be compared with field data.—Author's abstract

00428 **Weertman, J.** Sliding of nontemperate glaciers: Jour. Geophys. Research, v. 72, no. 2, p. 521–523, illus., 1967.

It is shown that if the bottom surface of a nontemperate glacier is at the melting point the glacier normally will slide despite the fact that obstacles in the bed may protrude into cold ice.—Author's abstract

10406 **Weertman, J.** Effect of a basal water layer on the dimensions of ice sheets: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 204, 22 p., illus., 1966.

This is the same paper as that published in Jour. Glaciology, v. 6, no. 44, p. 191–207, 1966. See Abstracts of North American Geology, January 1967.—V.S.N.

10470 **Weinman, Paul L.** An introduction to invertebrate fossils of New York: New York State Mus. and Sci. Service Educ. Leaflet 19, 13 p., illus., 1966.

This leaflet presents some of the elementary concepts of paleontology, with brief descriptions of the invertebrate phyla. Some common invertebrate fossils of New York (Cambrian–Devonian) are illustrated by drawings; generic names are given.—V.M.J.

10447 **Wentworth, Chester K.** Glaciation on Mauna Kea as evidence of Pleistocene climatic conditions in Hawaii, *in* Pleistocene and post–Pleistocene climatic variations in the Pacific area, a symposium—Pacific Sci. Cong., 10th, Honolulu, 1961: Honolulu, Hawaii, Bishop Mus. Press, p. 123–129, 1966.

Mauna Kea, at 13,796 feet, is the highest peak of the central Pacific area. Snow falls on the upper parts several times a year and remains for two or three weeks. From the present climate and alpine features, it is believed a 5°F lowering of temperature would produce glaciation today. The mountain reached its full height in the Pleistocene. A belt of moraines, 200–300 feet thick, occurs at 10,500 to 12,000 feet, cinder cones show slopes disturbed by glacial ice, and flows at the summit have been eroded by ice. More than one glaciation is indicated, perhaps down to 7,000 feet.—E.S.L.

00523 **Westermann, G. E. G.** The umbilical lobes of stephanoceratacean ammonites: Jour. Paleontology, v. 41, no. 1, p. 259–261, illus., 1967.

The internal lateral lobe of the Stephanoceratacean is an element without known homologues in other ammonites and should be designated by Schindewolf's term U_x. Other details of the umbilical lobe morphology of stephanoceratacean are discussed.—J.P.

00377 **Westgate, J. A.; Dreimanis, A.** Volcanic ash layers of Recent age at Banff National Park, Alberta, Canada: Canadian Jour. Earth Sci., v. 4, no. 1, p. 155–161, illus., tables, 1967.

The chemical and mineralogical composition of three distinctive volcanic ash layers, in postglacial sediments at Banff National Park, and radiocarbon age of associated charcoal, indicate the presence of Bridge River ash, derived from the heart of the southern Coast Mountains of British Columbia, and Mazama ash, from Mount Mazama at Crater Lake, Oregon. A maximal age for Bridge River ash is about 2670 yr B.P.; a minimal age is about 2120 yr B.P. Mazama ash, established as about 6600 yr, has a slightly younger date of about 6020 yr in Banff Park. Source and age of the third ash is not definitely known, but the presence of cummingtonite suggests it might be St. Helens Y ash, derived from Mount St. Helens, Washington.—G.D.C.

10535 **Weyl, P. K.** The solution behavior of carbonate materials in sea water [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 4, 1966.

10415 **Weyl, Richard.** Vulkane and Vulkanlandschaften in Mittelamerika: Natur u. Mus., v. 96, no. 12, p. 469–480, illus., table, 1966.

Types of volcanic landforms characteristic of Central America and the Antilles are described and illustrated. Poás, Costa Rica, and Paricutín, Mexico, are cited as typical volcanic cones in contrast to the volcanic depressions of Atitlán–See, Guatemala, Coatepeque–See and Ilopango–See, El Salvador. These depressions are common in Central America but rare in the Antilles where, however, calderas, such as Soufrières on Saint Lucia, are found. A geologic sketch map of this caldera is included. Another landform type is the lava plateau. Development of each type is dependent upon the quality and quantity of magma available. Andesitic eruptions built Paricutín, calderas with sharp peaks require silica–rich magma, and lava plateaus are built of silica–rich welded tuff.—E.S.L.

White, D. E. *See* Pearson, F. J., Jr. 00544

00520 **White, W. Arthur; Parham, Walter E.** Clay and shale resources of Clark, Crawford, Cumberland, Edgar, Effingham, Jasper, and Vermilion Counties, Illinois: Illinois Geol. Survey Indus. Minerals Note 29, 23 p., illus., tables, 1967.

Twenty–eight samples taken from shales and clays occurring in the Mattoon, Bond, and Modesto Formations in Clark, Crawford, Cumberland, Edgar, Effingham, Jasper, and Vermilion Counties, were tested to determine their potential ceramic properties. The clays and shales may be used for making drain tile, flower pots, pottery, refractories, sewer pipe, and structural clay products. The shales might be used in the manufacture of lightweight aggregate and ceramic block.—Authors' abstract

Whiteside, E. P. *See* Redmond, C. E. 00318

00311 **Whitmore, Frank C., Jr.; Foster, Helen L.** *Panthera atrox* (Mammalia: Felidae) from central Alaska: Jour. Paleontology, v. 41, no. 1, p. 247–251, illus., table, 1967.

A lower jaw of the large Pleistocene cat *Panthera atrox* (Leidy) was found on an alluvial flat about 180 mi northeast of Fairbanks, Alaska. It was probably washed out of carbonaceous silt deposits which, in the adjacent area, have also yielded bones of *Equus, Bison, Rangifer, Cervus,* and Elephantidae. The *Panthera* jaw falls within the size range of the series from Rancho La Brea, Calif., and differs from Rancho La Brea specimens only in a few characteristics. *P. atrox* appears to have been significantly larger than extinct or modern Asian tigers. Despite continuity of the American and Asian land masses at times during the late Pleistocene, present evidence indicates discontinuity between the populations of great cats on the two continents.—Authors' abstract

10428 **Whitney, Marion I.; Kellum, Lewis B.** Echinoids of the Glen Rose Limestone of Texas: Michigan Acad. Sci., Arts and Letters Papers 1965, v. 51, p. 241–263, illus., table, 1966.

Eleven species of cidaroid, diademoid, and atelostomate echinoids from the Glen Rose Limestone (middle formation of Trinity Group, Lower Cretaceous) are described and illustrated; most of the species are rare. The seven new species are: *Phyllacanthus tysoni, P. texanus, Salenia phillipsae, Orthopsis comalensis, Pseudodiadema elevatus, Holectypus ovatus, Pyrina hancockensis.*—V.M.J.

Wichmann, P. A. *See* Youmans, A. H. 10559

Wigley, Perry. *See* Carrington, Thomas J. 00442

10662 **Willey, Gordon R.** An introduction to American archaeology—V. 1, North and Middle America: Englewood Cliffs, N. J., Prentice–Hall, Inc., 530 p., illus., 1966.

In this volume the first two chapters present the early background for New World prehistory, summarizing physiography and ecology of the natural environment, Pleistocene glaciation and chronology, evidence of earliest Americans, types of artifacts and radiocarbon dates. The rest of the book deals with various cultures in numerous areas, of which the Old Cordilleran Tradition and the Big–Game Hunting may be earlier than 10,000 B.C. The presence of lanceolate and fluted

points of a more ancient Siberian culture may support the hypothesis of man's coming to America as far back as 20,000 B.C.—G.D.C.

10515 **Wilson, Charles W., Jr.** Geologic map of the Nashville West quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 308-NE, scale 1:24,000, separate text, 1966.

The accompanying text, "Mineral resources summary of the Nashville West quadrangle, Tennessee," by D. S. Fullerton and C. W. Wilson, Jr., 1966 is cited separately.—M.C.M.

10516 **Wilson, Charles W., Jr.** Geologic map of the La Vergne quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 311-SE, scale 1:24,000, separate text, 1966.

There are 11 limestone quarries in the La Vergne quadrangle, all abandoned. Of the six limestone formations that crop out, the Ridley, Carters, Lebanon, and Bigby-Cannon are most acceptable for general purposes. Barite has been mined at one place. Small deposits of gravel are scattered along the flood plains of Stones River and its tributaries and on a few small hills; these deposits might serve local uses.—M.C.M.

10517 **Wilson, Charles W., Jr.; Miller, Robert A.** Geologic map of the Milton quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 319-NW, scale 1:24,000, separate text, 1966.

The text (by Wilson) describes the mined mineral resources in the Milton quadrangle—limestone and minor amounts of zinc. Of the six abandoned limestone quarries, five are small and one is moderate in size. The Carters, Ridley, and Bigby-Cannon Limestones are most acceptable for general use. Zinc associated with small amounts of lead, barite, and fluorite was first found in 1889; since then the area has been prospected intermittently. Several unsuccessful test wells have been drilled for oil and gas.—M.C.M.

Wilson, Charles W., Jr. *See* Fullerton, Donald S. 10582

Wilson, Clyde A. *See* Cronin, James G. 00518

00502 **Wilson, L. R.; Skvarla, John J.** Electron-microscope study of the wall structure of *Quisquilites* and *Tasmanites*: Oklahoma Geology Notes, v. 27, no. 3, p. 54-63, illus., 1967.

Quisquilites buckhornensis, a supposed microscopic alga, was described from the Woodford Formation (Devonian) of Oklahoma in 1963. At that time a phylogenetic relationship was suggested with *Tasmanites*, also a common Woodford fossil. Subsequent studies involving phase microscopy and the electron microscope have strengthened the supposition and revealed previously unrecognized morphological structures which are common to both genera.—E.S.L.

10616 **Wilson, L. R.** Palynology of the Domebo site, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie Plains: Mus. Great Plains Contr., no. 1, p. 44-50, illus., 1966.

Histograms are constructed from pollen assemblages from samples of the 37-inch-thick blue clay layer of the lower member of the late Pleistocene Domebo Formation, representing the plant succession between 11,500 and 9,000 or 10,000 years ago, and one inch of surface litter, which shows a similar pollen spectrum; the 37-ft-thick upper member of the Domebo is barren of all but conifer pollen. The blue clay section is dominated throughout by grass and composite pollen, with amaranth and chenopod also important, representing vegetation of the regional prairie. Pollen of oak, hickory, and other trees and herbs represent woodland vegetation of the stream valley. A marked change in relative abundance of grass and composite pollen near the top of the blue clay suggests an ecological change in the regional prairie before deposition of the upper member.—V.M.J.

10643 **Wilson, L. R.** Palynological evidence for Mississippian age of the Springer Formation, *in* Pennsylvanian of the Ardmore Basin, southern Oklahoma—Ardmore Geol. Soc., Field Conf. 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., p. 20–24, illus., table, 1966.

The Caney, Goddard, and Springer Formations in the Arbuckle area contain more than 200 species of spores and pollen. Members of the lower Caney Shale contain genera and species almost entirely different from the overlying Sand Branch member, which contains a large number of Ordovician and Devonian marine microfossils and a scarcity of spores and pollen. The basal Goddard Shale with the same assemblage plus many Mississippian spores is considered correlative. The Goddard and Springer are palynologically a single unit, so both are placed in the Chester. Charts show ranges in Oklahoma and Europe of ten forms, illustrated by drawings. A stratigraphic chart gives the western European and the northern and southern Arbuckle Mountains classifications.—E.S.L.

00559 **Winston, Don; Nicholls, Harry.** Late Cambrian and Early Ordovician faunas from the Wilberns Formation of central Texas: Jour. Paleontology, v. 41, no. 1, p. 66–96, illus., 1967.

The Cambrian–Ordovician boundary is within the San Saba Member of the Wilberns. The Cambrian Trempealeauan *Saukia* Zone has three subzones, in ascending order: *Saukiella junia and S. norwalkensis* allied to Trempealeauan of Upper Mississippi Valley, and *Corbinia apopsis*, allied to *Hungaia magnifica* fauna. Low Ordovician zones are the *Mississquoia* (correlated to Vermont) and *Symphysurina* (correlated to Utah and Nevada). New trilobite species are *Acheilops masonensis, Bayfieldia simata, Bowmania sagitta, Briscoia llanoensis, Calvinella procera, Clelandia texana, Corbinia apopsis, C. implumis, Euptychaspis jugalis, Homagnostus reductus, Kiethiella patula, Leiobienvillia leonensis, Leiocoryphy halei, Mississquoia inflata, M. nasuta, Saukiella planata, and Symphysurina bubops.*—*from* Authors' abstract

10345 **Wold, Richard J.; Wolfe, Thomas R.** Computer methods of analyzing aeromagnetic data—U.S. Office Naval Research, Contract NONR 1202(25) NR 307–293, Final Rept.: Wisconsin Univ. Geophys. and Polar Research Center Research Rept. Ser. 66–1, 79 p., illus., tables, 1966.

Digitally recorded aeromagnetic data can be read directly by a computer, the readings converted to values in gammas, any erroneous readings eliminated, and the regional field due to the dipole nature of the geomagnetic field removed. The data may then be profiled on any map projection and scale. Also surface fits of various degree polynomials can be made to the original data and contoured by an X–Y plotter. Finally differences between various fitted surfaces can be contoured.—Authors' abstract

Wolfe, J. E. *See* Morrison, P. W. 10599

Wolfe, Thomas R. *See* Wold, Richard J. 10345

10609 **Worts, G. F., Jr.; Malmberg, G. T.** Hydrologic appraisal of Eagle Valley, Ormsby County, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources—Reconn. Ser. Rept. 39, 55 p., illus., tables, geol. map, 1966.

During the past five years water use in Eagle Valley has been increasing at a rate of nearly 200 acre-feet per year; in 1965 about 2,700 acre-feet were used for public and rural supply; ground water pumpage was minor. Estimated system yield of the valley from both surface- and ground-water sources is at least 10,000 acre-feet per year. In 1965 about 85 percent of the spring and streamflow but less than 15 percent of ground water supply had been developed. Based on projected population growth and water needs, the system yield estimated, if fully developed, would meet the needs of the area until about 1980.—*from* Authors' summary

10664 **Wright, G. M.; Duffell, S.** Fourteen years geological progress in the northern Canadian Shield, *in* Contributions to geological exploration in Canada: Canada Geol. Survey Paper 66–42, p. 4–7, illus., 1966.

This is the first report of a Cretaceous conchostracan in North America. They lived in brackish or fresh water, each surviving for one to two and a half months.—R.E.G.

10569 **Taylor, Donald M.** Project Mohole, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. FF1-FF2, 1966.

The need for greater knowledge of the mantle, and the successful completion of Phase I and progress on Phase II of Project Mohole are reviewed.—E.S.L.

Taylor, P. T. *See* Lee, W. H. K. 10382

Teichert, Curt. *See* Rhodes, F. H. T. 10471

00421 **Tennessee Division of Geology.** Status of detailed geologic mapping in Tennessee, January 1, 1967: Nashville, Tenn., Tennessee Div. Geology, 1 sheet, 1967.

10665 **Terasmae, J.; Webber, P. J.; Andrews, J. T.** A study in late-Quaternary plant-bearing beds in north-central Baffin Island, Canada [with French and Russian abs.]: Arctic, v. 19, no. 4, p. 296-318, illus., tables, 1966.

Buried plant-bearing beds along Isortoq River at the northern end of Barnes Ice Cap on Baffin Island have been [C-14] dated at more than 38,830 and 40,000 years B.P. A palynological and palaeobotanical study has indicated the presence of species (e.g. dwarf birch) which now occur several hundred kilometres south of this locality. Because of the inferred climatic conditions, more favourable than the present, an interglacial age (Sangamon) is assigned to the Isortoq plant-bearing beds. Folding of the Isortoq beds by overriding ice and the orientation of the overturned folds indicate accumulation of the initial ice cap east of this locality.—Authors' abstract

10524 **Terry, Richard D.** Continental slopes of the world [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 65, 1966.

Theokritoff, George. *See* Rasetti, Franco. 00531

Thiruvathukal, John V. *See* Berg, Joseph W., Jr. 10360

Thompson, Gary G. *See* Cross, Aureal T. 10509

Thornburn, T. H. *See* Liu, T. K. 10399

Thrasher, J. E. *See* Schoeppel, R. J. 10562

Thyer, J. R. *See* Holuj, F. 10650

00568 **Tillman, C. G.** *Triamara cutleri*, a new cystoid from the Osgood Formation (Silurian) of Indiana: Jour. Paleontology, v. 41, no. 1, p. 222-226, illus., 1967.

Triamara cutleri, n. gen., n. sp., is a diplopore-bearing stemless cystoid characterized by three unequally long, deeply impressed ambulacral grooves arranged in the form of a Y. An opening, inferred to be the peristome, is present several millimeters along the longest groove from the point of intersection of the three grooves. Each of the three arm bases appears to have borne two brachioles.—Author's abstract

00513 **Tomikel, John.** An indoor stratigraphy exercise: Jour. Geol. Education, v. 15, no. 1, p. 18, 1967.

The proposed exercise may be used in many schools instead of a field trip to climax geologic training, if conditions do not permit a trip. Samples of the strata in the field trip area should be accumulated and placed on movable shelves in the order in which they appear, dip indicated by tilting, and distance between shelves representing the thickness. Geographic locations should be listed by each column, and topographic maps given to the students, who should be able to identify

structures and make correlations. However, for an overall view there is no substitute for field work.—E.S.L.

10365 **Tomikel, John.** Physical geology—Lab manual and note book: Minneapolis, Minn., Burgess Publishing Co., 69 p., illus., 1966.

Work sheets for 18 laboratory sessions include mineral identification, rocks, topographic map studies, dip and strike, geologic map interpretation, fence diagrams, geologic structure studies, sedimentary deposits and their history, analysis of stream patterns, and four quadrangle studies, including Mt. Rainier, Wash., Whitewater, Wisc., Mammoth Cave, Ky., and Bright Angel, Ariz. Six extra exercises are included.—E.S.L.

Tomlinson, R. H. *See* McMullen, C. C. 10649

Toots, Heinrich. *See* Houston, R. S. 10623

10511 **Traverse, Alfred; Ginsburg, Robert N.** Palynology of the surface sediments of Great Bahama Bank, as related to water movement and sedimentation: Marine Geology, v. 4, no. 6, p. 417–459, illus., tables, 1966.

From a series of traverses on the Great Bank and from other locations about 130 sediment samples were analyzed for fossil pollen and other microfossils. Pine pollen is especially significant due to its buoyancy, by which it remains suspended in water for long periods and shows an apparent inverse relation to its distribution in the sediments. Microforaminiferal chitinous inner tests are found in abundance in some sediment stations where pollen highs are not found. Originally calcareous and typically bottom dwellers, foraminifers tend to be deposited in situ. Charts show distribution of pine and other pollen, microforaminiferal tests, hystrichosphaerids, and HCl-insoluble organic residues. Maceration-resistant microfossils in ancient carbonate banks may be a clue to water movements and sedimentation.—G.D.C.

Trembly, Lynn. *See* Berg, Joseph W., Jr. 10360

Treves, S. B. *See* Bayley, R. W. 10407

Tu, H. Y. *See* Barrows, H. L. 10435

10656 **Tubey, L. W.; Beaven, P. J.** A study of the petrology of some soft limestones from Jamaica in relation to their engineering properties: Harmondsworth Road Research Lab. RRI Rept. 21, 37 p., illus., tables, 1966.

The petrologic characteristics of soft limestones, mainly from Jamaica, were studied in thin sections cut from specimens impregnated with dyed resin. Laboratory tests show that the proportion of voids has a two-fold influence on strength; strength increases as void-content decreases and as the proportion of voids filled with calcitic cement increases. Voids are affected by the type and proportion of fossils. In general, a higher degree of correlation between petrologic and engineering properties occurs for the soft limestones than for harder roadstones. Petrologic examination could usefully be extended to other soft limestones to improve understanding of their engineering behavior.—*from* Authors' abstract

10419 **Turnock, A. C.** Synthetic wodginite, tapiolite, and tantalite: Canadian Mineralogist, v. 8, pt. 4, p. 461–470, illus., table, 1966.

Synthesis, phase relations, and physical properties of solid phases in the systems tantalite–tapiolite–oxygen and tantalite–$FeTaO_4$ are described. In pegmatitic magma enriched in Ta, Fe, and Mn, the occurrence of one or more of the minerals tantalite, tapiolite, and wodginite and their ferrous-ferric ratios are controlled by the partial pressure of oxygen.—B.C.H.

Uehara, G. *See* Swindale, L. D. 10401

10501 **Upson, Joseph E.** Salt-water encroachment problems of coastal aquifers with special reference to northwestern Europe and northeastern United States, *in* Am.

Water Resources Conf., 2d Ann., Chicago, 1966, Proc.: Am. Water Resources Assoc. Proc. Ser., no. 2, p. 38–46, illus., 1966.

In the Netherlands region salty water extends far inland in glacial deposits, and thin sheets and discrete bodies of fresh ground water extend into salt water beneath high coastal sand dunes. The Chalk of Denmark and England contains salty water probably unrelated to the present sea. In northeastern United States, in older formations between Maryland and New Jersey, salty water occurs many miles inland and fresh water extends substantial distances out to sea; at some coastal spots a single well may penetrate alternating lenses. Along the Atlantic Coast are no dunes comparable to those of the Netherlands, but many miles of narrow barrier beaches in which lenses of fresh water surrounded by sea water are replenished by rainfall; some deeper confined aquifers are recharged by underground flow from land. G.D.C.

00497 **U.S. Bureau of Mines.** Production potential of known gold deposits in the United States: U.S. Bur. Mines Inf. Circ. 8331, 24 p., illus., tables, 1967.

The 1,300 lode and placer deposits which include most of the significant gold reserves in the United States are estimated to contain 400 million ounces of gold. Only 9 million ounces, of which nearly 96 percent is in producing lode mines in Nevada and South Dakota, could be mined at 35 dollars per ounce with prevailing mining and metallurgical techniques. Significant increase in available gold, barring an increase in price, will depend either on discovery of new sources, intensive exploration in the most promising known mineralized areas, or development of new technology.—C.S.B.

10433 **U.S. Geological Survey.** Geological Survey research 1966, Chap. A: U.S. Geol. Survey Prof. Paper 550–A, p. A1–A385, illus., 1966.

This volume summarizes results of investigations during 1966 of natural resources, geology and hydrology applied to engineering and public health, regional geology, countries other than U.S., principles and processes, and topographic surveys and mapping. Additional information includes publications program, cooperators during fiscal year 1966, Geological Survey offices, investigations in progress in Geologic, Water Resources, and Conservation Divisions, contents of chapters B, C, and D of Geological Survey research 1966, publications by Survey authors, and indexes.—M.C.M.

Valenciano, Santos. *See* Takasaki, K. J. 10339

00610 **Valentine, J. W.; Peddicord, R. G.** Evaluation of fossil assemblages by cluster analysis: Jour. Paleontology, v. 41, no. 2, p. 502–507, illus., 1967.

Cluster analysis is used to group 66 fossil collections containing 246 species of mollusks from the California marine Pleistocene. An unweighted coefficient of Fager ($FC = C/\sqrt{(ab)} - 1/2\sqrt{\min(a,b)}$) is used for relating samples where a and b are the numbers of species contained in collections A and B, C is the number of species in common between samples A and B, and min (a,b) is the smaller of the values of a or b. Clustering is done by a modification of the weighted pair group method of Sokal and SNEATH. Major factors interpreted as affecting the clustering of the collections include: major facies represented (in this case rocky shores); geographic location; and relative contribution of special habitats.—J.F.M.

00478 **VanSchmus, W. R.; Koffman, D. M.** Equilibration temperatures of iron and magnesium in chondritic meteorites: Science, v. 155, no. 3765, p. 1009–1011, illus., table, 1967.

The distribution coefficients for Fe^{++} and Mg^{++} were calculated from new microprobe analyses of coexisting olivine, orthopyroxene, and calcic pyroxene in chondritic meteorites. Interpretation of the data shows that (1) the equilibration temperatures were of the order of 850°C, and (2) the olivine orthopyroxene partition does not reflect ideal behavior. This equilibration temperature is much lower than previous estimates.—Authors' abstract

VanSickle, Gordon H. *See* Gott, Garland B., Jr. 00454

VanWeele, B. *See* Herbich, John B. 10580

00323 **Vaughn, Peter Paul.** Evidence of ossified vertebrae in actinopterygian fish of early Permian age, from southeastern Utah: Jour. Paleontology, v. 41, no. 1, p. 151–160, illus., 1967.

Vertebral centra, about a millimeter high, were found in what appear to be transitional beds between Wolfcampian marine carbonates and the redbeds of the Cutler Group. They are of quadripartite structure; each consists of a calcified "notochordal plug", an hourglass of dense bone, a collar of spongy bone, and unossified arch bases. They most closely resemble the centra of the amiiform holosteans, including the living *Amia*. This structure is of a degree of advancement heretofore unsuspected for early Permian time.—*from* Author's abstract

10635 **Viele, George W.** Fabric analysis of folded sedimentary rocks, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 222–244, illus., 1966.

For structural geologists a simple and useful tool is the stereographic net. Essentially it is a three dimensional protractor permitting easy calculation of the attitudes of fold axes and axial planes, these elements completely defining the geometry of a fold. Examples are given of the calculations. To discern regional tectonic styles, fabric diagrams of poles to bedding planes and synoptic diagrams of fold axes and axial planes are a valuable supplement to geologic mapping. Examples are given from areas of complex structure in the Ouachita Mountains of Arkansas.—Author's abstract

10636 **Viele, George W.** The regional structure of the Ouachita Mountains of Arkansas, a hypothesis, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 245–278, illus., geol. map, 1966.

For this region a broad arched nappe or series of nappes is suggested, of which the Little Rock salient is a strongly digital limb. From southwest to northeast, all planar elements rotate from horizontal to northeast-dipping attitudes. Recumbent folds, isoclinal near Benton, occur as far west as Ida, Ark., where a thrust overrides them. On the northeast edge of the Ouachitas is a glide plane for a series of landslides of detached Carboniferous sediments. Flattening in the decollement zone accounts for displacement of thrust faults rooted north of the Benton–Broken Bow uplift; those south of the uplift may be back limb shears or foreland of a coastal plain nappe. Two tectonic models are suggested: an Ouachita core carrying and folding a suprastructure of Carboniferous sediments, and a basement uplift causing northward sliding of lower Paleozoic strata, then of Carboniferous sediments.—G.D.C.

00431 **Voight, Barry.** On photoelastic techniques, *in situ* stress and strain measurement, and the field geologist: Jour. Geology, v. 75, no. 1, p. 46–58, illus., 1967.

Determination of stress in rocks in the field is feasible by use of photoelastic strain gages. The biaxial strain gage consists of a polished disk of optical strain-sensitive material with a central hole. The disk is cemented to the surface of a rock under stress and then removed by overcoring. The resulting strain in the disk may be analyzed in polarized light and translated into terms of original shear intensities and directions. The uniaxial strain gage consists of a rectangular pre-stressed plate of epoxy and is convenient for determination of magnitudes of principal strain, once the principal directions are known.—R.E.W.

Voight, G. K. *See* Boyle, J. R. 00358

00552 **Voight, Harold.** In memoriam—Ralph Gregory Nichols (1916–1966): Houston Geol. Soc. Bull., v. 9, no. 5, p. 18, 1967.

10483 **vonHuene, Roland.** Glacial-marine geology of Nuka Bay, Alaska, and the adjacent continental shelf: Marine Geology, v. 4, no. 4, p. 291–304, illus., 1966.

Structures interpreted from continuous seismic reflection profiles indicate that the glacier which last filled Nuka Bay had a stationary terminus for a time at the fiord's present topographic sill and then receded very rapidly. Sediments deposited since this major recession are undisturbed by possible subsequent minor glacial advances. Settling of material from suspension, slumping, and local density or bottom currents have distributed sediment in closed basins of the fiord's rugged basement topography. The glacial appearance of topographic ridges on the continental shelf off the Kenai Peninsula does not result from the accumulation of glacial drift but is more likely the product of erosion, tectonism, and proglacial deposition. Some bathymetric features previously thought to show the extent of ice during the last glaciation are now believed to have been formed tectonically.—Author's summary

10529 **vonHuene, Roland; Shor, George G., Jr.** Structure of the continental to oceanic transition in the Gulf of Alaska [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 9], p. 72, 1966.

Vossler, Donald A. *See* Berg, Joseph W., Jr. 10360

Waagé, Karl M. *See* Denson, Norman M. 10440

Waananen, A. O. *See* Kachadoorian, Reuben. 00355

Walker, Leland J. *See* Am. Society for Testing and Materials. 10340

Walker, R. M. *See* Huang, W. H. 00499

00437 **Walker, Theodore R.** Formation of red beds in modern and ancient deserts: Geol. Soc. America Bull., v. 78, no. 3, p. 353–368, illus., table, 1967.

From a study of Recent, Pleistocene, and Pliocene red beds deposited in fluvial and fluvial-marine transitional environments in the Sonoran desert of northeastern Baja California, it is concluded that the red beds were formed after deposition in hot arid or semiarid climates. They are associated with evaporites in an area where faunal, floral, and pedological evidence indicates a low rainfall. Both red conglomerates and red intertidal muds show that alteration of hornblende and biotite produced red hematite stained red beds. The late Paleozoic red beds of Colorado are interpreted as analogs.—R.G.Y.

10653 **Walthall, Bennie H.; Bowsher, Arthur L.** Geology of part of southern Ouachitas, Arkansas, *in* Flysch facies and structure of the Ouachita Mountains—Kansas Geol. Soc., 29th Field Conf., 1966, Guidebook: Wichita, Kans., Kansas Geol. Soc., p. 125–139, illus., geol. map, 1966.

The Athens plateau, chiefly in Pike County, has the only surface exposures of the Ouachita structural province south of the Broken Bow-Benton uplift. The complexly folded and faulted Paleozoic strata are onlapped from the south by the Cretaceous Trinity Group. The stratigraphy of the underlying Mississippian-Pennsylvanian sequences (Stanley through Atoka) is summarized. Their close similarity in the frontal belt, central Ouachitas, and Athens plateau suggests one depositional basin. In the Athens plateau the sequence is much thicker with a larger proportion of detrital pebbles becoming more abundant and larger in the south-southeast pointing to that source direction. The structure in the Athens plateau is that of parallel, ruptured, recumbent anticlines with tight folds and steep fault planes, homologous with the frontal belt.—G.D.C.

Walton, W. C. *See* Ackroyd, E. A. 00458

Ward, A. E. *See* Grose, L. T. 00619

10607 **Ward, Peter; Ward, Sandra.** Volcanic activity in Katmai National Monument, in early August, 1965: Earthquake Notes, v. 37, no. 3, p. 19–34, illus., tables, 1966.

From August 3 until August 5, 1965, a heavy concentration of dust and some sulphurous fumes were noted in the Valley of 10,000 Smokes and the Brooks River area of Katmai National Monument, Alaska. Visual and seismic observations during July and August indicated that although there was no major volcanic eruption, there was a slight increase of seismic activity in late July near Mt. Trident and in early August near Mt. Martin. Observations of volcanic activity, however, in the Katmai region during 1965, were inadequate to relate volcanic and seismic events. While an aeolian origin for the observed dust and fumes cannot be ruled out, some type of volcanic activity seems likely.—Authors' abstract

Ward, Sandra. *See* Ward, Peter. 10607

Wartburg, A. F. *See* Cadle, R. D. 00433

Wasserburg, G. J. *See* Steiger, Rudolf H. 10445

00357 **Wasson, John T.; Alder, B.; Oeschger, H.** Aluminum-26 in Pacific sediment—Implications: Science, v. 155, no. 3761, p. 446–448, illus., tables, 1967.

Al 26 has been detected in a sample of sediment from the South Pacific. The disintegration rate of 0.8 dpm per kg of dry sediment is considerably higher than that expected from cosmic-spallation of atmospheric argon; it appears to result mainly from accretion of activity induced in interplanetary dust by solar-flare particles. This finding is in keeping with Wasson's published estimate regarding the magnitude of this effect, and confirms the order-of-magnitude correctness of the solar particle flux and terrestrial accretion rate of interplanetary dust used in that calculation.—Authors' abstract

00473 **Wasson, John T.** Concentrations of Ni, Ga, and Ge in a series of Canyon Diablo and Odessa meteorite specimens: Jour. Geophys. Research, v. 72, no. 2, p. 721–730, illus., tables, 1967.

The Ni, Ga, and Ge concentrations in two samples of Odessa and six of Canyon Diablo were determined. In Canyon Diablo the range of Ni concentrations is 7.0–8.2 percent, in agreement with earlier studies; the range of Ga concentrations, 79–83 ppm, is considerably smaller than previously reported; and Ge concentrations range from 317 to 332 ppm. Concentrations of all three elements were similar in Odessa. These data and the structure of the meteorites suggest that Canyon Diablo and Odessa are members of the same genetically related Ga–Ge group but are not likely to be "paired falls." The six Canyon Diablo specimens, which include atypical No. 2 and No. 3, are all parts of the same meteoroid.—D.B.V.

Webber, P. J. *See* Terasmae, J. 10665

10421 **Weber, J. B.** Molecular structure and pH effects on the adsorption of 13 *s*-triazine compounds on montmorillonite clay: Am. Mineralogist, v. 51, nos. 11–12, p. 1657–1670, illus., tables, 1966.

The adsorption of 13 related *s*-triazine compounds on montmorillonite clay as influenced by pH and molecular structure was investigated. Adsorption isotherms for prometone on montmorillonite were determined at six pH levels. The maximum adsorption of all the compounds on montmorillonite was found to occur at a pH in the vicinity of the pK_a value of each compound. Substituent groups on the triazine ring were found to be related to the amount of adsorption which resulted. Mechanisms of adsorption were postulated and discussed.—Author's abstract

00362 **Weertman, J.** An examination of the Lliboutry theory of glacier sliding: Jour. Glaciology, v. 6, no. 46, p. 489–494, 1967.

An examination is made of the Lliboutry theory of glacier sliding. It is concluded that this theory is incompletely developed and therefore it is impossible at present to make meaningful predictions of the sliding velocity from it that might be compared with field data.—Author's abstract

00428 **Weertman, J.** Sliding of nontemperate glaciers: Jour. Geophys. Research, v. 72, no. 2, p. 521–523, illus., 1967.

It is shown that if the bottom surface of a nontemperate glacier is at the melting point the glacier normally will slide despite the fact that obstacles in the bed may protrude into cold ice.—Author's abstract

10406 **Weertman, J.** Effect of a basal water layer on the dimensions of ice sheets: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 204, 22 p., illus., 1966.

This is the same paper as that published in Jour. Glaciology, v. 6, no. 44, p. 191–207, 1966. See Abstracts of North American Geology, January 1967.—V.S.N.

10470 **Weinman, Paul L.** An introduction to invertebrate fossils of New York: New York State Mus. and Sci. Service Educ. Leaflet 19, 13 p., illus., 1966.

This leaflet presents some of the elementary concepts of paleontology, with brief descriptions of the invertebrate phyla. Some common invertebrate fossils of New York (Cambrian–Devonian) are illustrated by drawings; generic names are given.—V.M.J.

10447 **Wentworth, Chester K.** Glaciation on Mauna Kea as evidence of Pleistocene climatic conditions in Hawaii, *in* Pleistocene and post-Pleistocene climatic variations in the Pacific area, a symposium—Pacific Sci. Cong., 10th, Honolulu, 1961: Honolulu, Hawaii, Bishop Mus. Press, p. 123–129, 1966.

Mauna Kea, at 13,796 feet, is the highest peak of the central Pacific area. Snow falls on the upper parts several times a year and remains for two or three weeks. From the present climate and alpine features, it is believed a 5°F lowering of temperature would produce glaciation today. The mountain reached its full height in the Pleistocene. A belt of moraines, 200–300 feet thick, occurs at 10,500 to 12,000 feet, cinder cones show slopes disturbed by glacial ice, and flows at the summit have been eroded by ice. More than one glaciation is indicated, perhaps down to 7,000 feet.—E.S.L.

00523 **Westermann, G. E. G.** The umbilical lobes of stephanoceratacean ammonites: Jour. Paleontology, v. 41, no. 1, p. 259–261, illus., 1967.

The internal lateral lobe of the Stephanoceratoceae is an element without known homologues in other ammonites and should be designated by Schindewolf's term U_s. Other details of the umbilical lobe morphology of stephanoceratoceans are discussed.—J.P.

00377 **Westgate, J. A.; Dreimanis, A.** Volcanic ash layers of Recent age at Banff National Park, Alberta, Canada: Canadian Jour. Earth Sci., v. 4, no. 1, p. 155–161, illus., tables, 1967.

The chemical and mineralogical composition of three distinctive volcanic ash layers, in postglacial sediments at Banff National Park, and radiocarbon age of associated charcoal, indicate the presence of Bridge River ash, derived from the heart of the southern Coast Mountains of British Columbia, and Mazama ash, from Mount Mazama at Crater Lake, Oregon. A maximal age for Bridge River ash is about 2670 yr B.P.; a minimal age is about 2120 yr B.P. Mazama ash, established as about 6600 yr, has a slightly younger date of about 6020 yr in Banff Park. Source and age of the third ash is not definitely known, but the presence of cummingtonite suggests it might be St. Helens Y ash, derived from Mount St. Helens, Washington.—G.D.C.

10535 **Weyl, P. K.** The solution behavior of carbonate materials in sea water [abs.], *in* Abstracts of papers related with oceanography—Pacific Sci. Cong., 11th, Tokyo, 1966, Proc., V. 2: Tokyo, Sci. Council Japan [Sec. 10], p. 4, 1966.

10415 **Weyl, Richard.** Vulkane and Vulkanlandschaften in Mittelamerika: Natur u. Mus., v. 96, no. 12, p. 469–480, illus., table, 1966.

Types of volcanic landforms characteristic of Central America and the Antilles are described and illustrated. Poás, Costa Rica, and Paricutín, Mexico, are cited as typical volcanic cones in contrast to the volcanic depressions of Atitlán–See, Guatemala, Coatepeque–See and Ilopango–See, El Salvador. These depressions are common in Central America but rare in the Antilles where, however, calderas, such as Soufrières on Saint Lucia, are found. A geologic sketch map of this caldera is included. Another landform type is the lava plateau. Development of each type is dependent upon the quality and quantity of magma available. Andesitic eruptions built Paricutín, calderas with sharp peaks require silica–rich magma, and lava plateaus are built of silica–rich welded tuff.—E.S.L.

White, D. E. *See* Pearson, F. J., Jr. 00544

00520 **White, W. Arthur; Parham, Walter E.** Clay and shale resources of Clark, Crawford, Cumberland, Edgar, Effingham, Jasper, and Vermilion Counties, Illinois: Illinois Geol. Survey Indus. Minerals Note 29, 23 p., illus., tables, 1967.

Twenty–eight samples taken from shales and clays occurring in the Mattoon, Bond, and Modesto Formations in Clark, Crawford, Cumberland, Edgar, Effingham, Jasper, and Vermilion Counties, were tested to determine their potential ceramic properties. The clays and shales may be used for making drain tile, flower pots, pottery, refractories, sewer pipe, and structural clay products. The shales might be used in the manufacture of lightweight aggregate and ceramic block.—Authors' abstract

Whiteside, E. P. *See* Redmond, C. E. 00318

00311 **Whitmore, Frank C., Jr.; Foster, Helen L.** *Panthera atrox* (Mammalia: Felidae) from central Alaska: Jour. Paleontology, v. 41, no. 1, p. 247–251, illus., table, 1967.

A lower jaw of the large Pleistocene cat *Panthera atrox* (Leidy) was found on an alluvial flat about 180 mi northeast of Fairbanks, Alaska. It was probably washed out of carbonaceous silt deposits which, in the adjacent area, have also yielded bones of *Equus, Bison, Rangifer, Cervus,* and Elephantidae. The *Panthera* jaw falls within the size range of the series from Rancho La Brea, Calif., and differs from Rancho La Brea specimens only in a few characteristics. *P. atrox* appears to have been significantly larger than extinct or modern Asian tigers. Despite continuity of the American and Asian land masses at times during the late Pleistocene, present evidence indicates discontinuity between the populations of great cats on the two continents.—Authors' abstract

10428 **Whitney, Marion I.; Kellum, Lewis B.** Echinoids of the Glen Rose Limestone of Texas: Michigan Acad. Sci., Arts and Letters Papers 1965, v. 51, p. 241–263, illus., table, 1966.

Eleven species of cidaroid, diademoid, and atelostomate echinoids from the Glen Rose Limestone (middle formation of Trinity Group, Lower Cretaceous) are described and illustrated; most of the species are rare. The seven new species are: *Phyllacanthus tysoni, P. texanus, Salenia phillipsae, Orthopsis comalensis, Pseudodiadema elevatus, Holectypus ovatus, Pyrina hancockensis.*—V.M.J.

Wichmann, P. A. *See* Youmans, A. H. 10559

Wigley, Perry. *See* Carrington, Thomas J. 00442

10662 **Willey, Gordon R.** An introduction to American archaeology—V. 1, North and Middle America: Englewood Cliffs, N. J., Prentice–Hall, Inc., 530 p., illus., 1966.

In this volume the first two chapters present the early background for New World prehistory, summarizing physiography and ecology of the natural environment, Pleistocene glaciation and chronology, evidence of earliest Americans, types of artifacts and radiocarbon dates. The rest of the book deals with various cultures in numerous areas, of which the Old Cordilleran Tradition and the Big–Game Hunting may be earlier than 10,000 B.C. The presence of lanceolate and fluted

points of a more ancient Siberian culture may support the hypothesis of man's coming to America as far back as 20,000 B.C.—G.D.C.

10515 **Wilson, Charles W., Jr.** Geologic map of the Nashville West quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 308-NE, scale 1:24,000, separate text, 1966.

The accompanying text, "Mineral resources summary of the Nashville West quadrangle, Tennessee," by D. S. Fullerton and C. W. Wilson, Jr., 1966 is cited separately.—M.C.M.

10516 **Wilson, Charles W., Jr.** Geologic map of the La Vergne quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 311-SE, scale 1:24,000, separate text, 1966.

There are 11 limestone quarries in the La Vergne quadrangle, all abandoned. Of the six limestone formations that crop out, the Ridley, Carters, Lebanon, and Bigby–Cannon are most acceptable for general purposes. Barite has been mined at one place. Small deposits of gravel are scattered along the flood plains of Stones River and its tributaries and on a few small hills; these deposits might serve local uses.—M.C.M.

10517 **Wilson, Charles W., Jr.; Miller, Robert A.** Geologic map of the Milton quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 319-NW, scale 1:24,000, separate text, 1966.

The text (by Wilson) describes the mined mineral resources in the Milton quadrangle—limestone and minor amounts of zinc. Of the six abandoned limestone quarries, five are small and one is moderate in size. The Carters, Ridley, and Bigby–Cannon Limestones are most acceptable for general use. Zinc associated with small amounts of lead, barite, and fluorite was first found in 1889; since then the area has been prospected intermittently. Several unsuccessful test wells have been drilled for oil and gas.—M.C.M.

Wilson, Charles W., Jr. *See* Fullerton, Donald S. 10582

Wilson, Clyde A. *See* Cronin, James G. 00518

00502 **Wilson, L. R.; Skvarla, John J.** Electron-microscope study of the wall structure of *Quisquilites* and *Tasmanites*: Oklahoma Geology Notes, v. 27, no. 3, p. 54–63, illus., 1967.

Quisquilites buckhornensis, a supposed microscopic alga, was described from the Woodford Formation (Devonian) of Oklahoma in 1963. At that time a phylogenetic relationship was suggested with *Tasmanites*, also a common Woodford fossil. Subsequent studies involving phase microscopy and the electron microscope have strengthened the supposition and revealed previously unrecognized morphological structures which are common to both genera.—E.S.L.

10616 **Wilson, L. R.** Palynology of the Domebo site, *in* Domebo—A Paleo-Indian mammoth kill in the Prairie Plains: Mus. Great Plains Contr., no. 1, p. 44–50, illus., 1966.

Histograms are constructed from pollen assemblages from samples of the 37-inch-thick blue clay layer of the lower member of the late Pleistocene Domebo Formation, representing the plant succession between 11,500 and 9,000 or 10,000 years ago, and one inch of surface litter, which shows a similar pollen spectrum; the 37-ft-thick upper member of the Domebo is barren of all but conifer pollen. The blue clay section is dominated throughout by grass and composite pollen, with amaranth and chenopod also important, representing vegetation of the regional prairie. Pollen of oak, hickory, and other trees and herbs represent woodland vegetation of the stream valley. A marked change in relative abundance of grass and composite pollen near the top of the blue clay suggests an ecological change in the regional prairie before deposition of the upper member.—V.M.J.

10643 **Wilson, L. R.** Palynological evidence for Mississippian age of the Springer Formation, *in* Pennsylvanian of the Ardmore Basin, southern Oklahoma—Ardmore Geol. Soc., Field Conf. 1966, Guidebook: Ardmore, Okla., Ardmore Geol. Soc., p. 20–24, illus., table, 1966.

The Caney, Goddard, and Springer Formations in the Arbuckle area contain more than 200 species of spores and pollen. Members of the lower Caney Shale contain genera and species almost entirely different from the overlying Sand Branch member, which contains a large number of Ordovician and Devonian marine microfossils and a scarcity of spores and pollen. The basal Goddard Shale with the same assemblage plus many Mississippian spores is considered correlative. The Goddard and Springer are palynologically a single unit, so both are placed in the Chester. Charts show ranges in Oklahoma and Europe of ten forms, illustrated by drawings. A stratigraphic chart gives the western European and the northern and southern Arbuckle Mountains classifications.—E.S.L.

00559 **Winston, Don; Nicholls, Harry.** Late Cambrian and Early Ordovician faunas from the Wilberns Formation of central Texas: Jour. Paleontology, v. 41, no. 1, p. 66–96, illus., 1967.

The Cambrian–Ordovician boundary is within the San Saba Member of the Wilberns. The Cambrian Trempealeauan *Saukia* Zone has three subzones, in ascending order: *Saukiella junia and S. norwalkensis* allied to Trempealeauan of Upper Mississippi Valley, and *Corbinia apopsis*, allied to *Hungaia magnifica* fauna. Low Ordovician zones are the *Missisquoia* (correlated to Vermont) and *Symphysurina* (correlated to Utah and Nevada). New trilobite species are *Acheilops masonensis, Bayfieldia simata, Bowmania sagitta, Briscoia llanoensis, Calvinella procera, Clelandia texana, Corbinia apopsis, C. implumis, Euptychaspis jugalis, Homagnostus reductus, Kiethiella patula, Leiobienvillia leonensis, Leiocoryphy halei, Missisquoia inflata, M. nasuta, Saukiella planata, and Symphysurina bubops.*—*from* Authors' abstract

10345 **Wold, Richard J.; Wolfe, Thomas R.** Computer methods of analyzing aeromagnetic data—U.S. Office Naval Research, Contract NONR 1202(25) NR 307–293, Final Rept.: Wisconsin Univ. Geophys. and Polar Research Center Research Rept. Ser. 66–1, 79 p., illus., tables, 1966.

Digitally recorded aeromagnetic data can be read directly by a computer, the readings converted to values in gammas, any erroneous readings eliminated, and the regional field due to the dipole nature of the geomagnetic field removed. The data may then be profiled on any map projection and scale. Also surface fits of various degree polynomials can be made to the original data and contoured by an X–Y plotter. Finally differences between various fitted surfaces can be contoured.—Authors' abstract

Wolfe, J. E. *See* Morrison, P. W. 10599

Wolfe, Thomas R. *See* Wold, Richard J. 10345

10609 **Worts, G. F., Jr.; Malmberg, G. T.** Hydrologic appraisal of Eagle Valley, Ormsby County, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources—Reconn. Ser. Rept. 39, 55 p., illus., tables, geol. map, 1966.

During the past five years water use in Eagle Valley has been increasing at a rate of nearly 200 acre feet per year; in 1965 about 2,700 acre-feet were used for public and rural supply; ground water pumpage was minor. Estimated system yield of the valley from both surface and ground water sources is at least 10,000 acre-feet per year. In 1965 about 85 percent of the spring and streamflow but less than 15 percent of ground-water supply had been developed. Based on projected population growth and water needs, the system yield estimated, if fully developed, would meet the needs of the area until about 1980.—*from* Authors' summary

10664 **Wright, G. M.; Duffell, S.** Fourteen years geological progress in the northern Canadian Shield, *in* Contributions to geological exploration in Canada: Canada Geol. Survey Paper 66–42, p. 4–7, illus., 1966.

The greatly increased pace of investigation from 1952–65 by the Geological Survey of Canada and provincial authorities in the Canadian Shield north of 52° lat has been due to general interest in the north, increased staffs, greater demand for minerals and metals, and most important, the adaptation and application of light aircraft and helicopters to geological surveying. Reconnaissance studies are followed by more detailed studies in specific areas and on specific problems; nine such examples are described briefly and indicated on a sketch map. The Survey has available the necessary chemical analyses, isotopic age determinations, geophysics, and geochemistry to support exploratory work. The ultimate objective is an understanding of the geological history and processes in the Canadian Shield. M.C.M.

Wrucke, Ronald R. *See* Hayden, John W. 10486

Yamanaga, George. *See* Davis, Dan A. 10354

Yamane, G. *See* Sibley, E. A. 10409

Yerkes, R. F. *See* Kachadoorian, Reuben. 00355

10559 **Youmans, A. H.; Hopkinson, E. C.; Wichmann, P. A.** Neutron lifetime logging in theory and practice, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. Q1–Q17, illus., table, 1966.

The Neutron Lifetime Log provides a sensitive and accurate means for monitoring progressive changes which take place in hydrocarbon reservoirs by intercomparing logs run in individual selected wells at different times. The principles involved in monitor logging are discussed and applications of the method are considered. The effects of borehole parameters on "pulsed neutron" logging are discussed and it is shown by test results that the Neutron Lifetime Log is superior in this regard. The use of a neutron detector as proposed in the Russian literature is shown to produce a log which is influenced to a greater extent by borehole conditions. Authors' abstract

Youmans, Arthur H. *See* Zenor, Hughes M. 10560

10485 **Yund, Richard A.; Kullerud, Gunnar.** Thermal stability of assemblages in the Cu–Fe–S system: Jour. Petrology, v. 7, no. 3, p. 454–488, illus., tables, 1966.

Phase relations in this system were determined from 700°C to 200°C in most portions, and below 100°C in restricted areas. Near solid solution limits for bornite, chalcopyrite, and pyrrhotite were determined at elevated temperatures, and stable assemblages at low temperatures, with less emphasis on composition of coexisting phases. The slow rates of tie-line reactions below 324°C allow higher temperature assemblages in some ores. Cubic-tetragonal inversion in chalcopyrite, as deduced by twins, depends upon correct interpretation of twinning, which is also commonly produced through deformation. A new x-bornite is very similar to sulfur-rich bornites which when heated exsolve chalcopyrite and digenite. The experiments indicate that "chalcopyrrhotite" is really tetragonal or isometric cubanite, and valleriite a low-temperature polymorph of chalcopyrite. —G.D.C.

10563 **Zablocki, C. J.** Some applications of geophysical logging methods in mineral exploration drill holes, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. U1–U13, illus., 1966.

The U.S. Geological Survey has been evaluating conventional electric logging, continuous measurements of magnetic susceptibility, and induced polarization in exploration drill holes. Various methods have proven useful in specific areas, as: electric resistivity logs to distinguish enriched hematite ores from noncommercial carbonate iron formations, as in the Lake Superior district; magnetic susceptibility logs to estimate relative amounts of magnetite in taconite ores (northern Wisconsin, central California); combination of resistivity and magnetic susceptibility logs to determine amount of magnetite necessary for a rock to appear electrically continuous

(parameters vary in different types of magnetite deposits—northern Wisconsin cf. central California); induced polarization logs to locate and determine distribution of disseminated sulfides and native copper (northern Wisconsin, Michigan).—*from* Author's abstract

Zaitzeff, James B. *See* Cross, Aureal T. 10509

10458 **Zen, E-an.** Some topological relationships in multisystems of n+3 phases—[Pt.] 1, General theory: unary and binary systems: Am. Jour. Sci., v. 264, no. 6, p. 401–427, illus., tables, 1966.

An n component (n+3) phase multisystem has n+3 invariant points and (n+3)(n+2)/2 univariant lines. In the absence of thermochemical data for all phases, chemographic relations and topologic considerations permit limited predictions about the nature of a p–T grid. An internally consistent grid of invariant points and univariant lines constitutes a net. Nets may be closed, partially open, or open. Closed nets may or may not be realistic, but can be used to generate congruent sequences of partially open and open nets. For each n component multisystem of n+3 phases, there are $C(n+3,n)=(n+3)(n+2)(n+1)/6$ different divariant assemblages. There are as many possible closed nets as there are divariant fields. To transform these nets from one another, the concept of representation polyhedron is introduced, which is an artificial construction that summarizes the possible topological relations of all p–T nets.

00533 **Zenger, Donald H.** Coloration of the "pink *Chonetes*" (brachiopod) of the Onondaga Limestone, New York: Jour. Paleontology, v. 41, no. 1, p. 161–166, illus., 1967.

Numerous examples of colored fossils have been reported from the geologic record. The "Pink *Chonetes Zone*" is a stratigraphic marker in the Middle Devonian (Eifelian) Onondaga Limestone of central New York. Electron probe microanalysis, coupled with more conventional techniques, shows that the coloration of the brachiopod is not due to original organic pigmentation but to small grains of iron oxide within the secondary pseudopunctate layer of the shells. Other reddish brachiopods observed thus far are also pseudopunctate.—Author' abstract

10560 **Zenor, Hughes M.; Zenor, John J.; Youmans, Arthur H.** Focus Log geometrical factors, *in* SPWLA Logging Symposium, 7th Ann., Tulsa, Okla., 1966, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. R1–R17, illus., tables, 1966.

A digital computer program has been used to calculate the response of the Focus Log in various geometric configurations with symmetry about the Z axis. Calculations for thin beds and invasion problems indicate that correction factors may be computed for use in both qualitative and quantitative interpretation of Focus Log data.—Authors' abstract

Zenor, John J. *See* Zenor, Hughes M. 10560

10549 **Ziegler, A. M.** The Silurian brachiopod *Eocoelia hemisphaerica* (J. de C. Sowerby) and related species: Palaeontology, v. 9, pt. 4, p. 523–543, illus., tables, 1966.

The atrypacean *Eocoelia* occurs widely in Upper Llandovery and lower Wenlock (Lower and Middle Silurian) deposits in Great Britain, eastern North America, and elsewhere. Evolutionary trends in the progressive suppression of ribs and strengthening of the articulatory mechanism are used to define four successive species, providing a reliable basis for fine-scale correlation: *E. hemisphaerica*, of C_1–C_2 age; *E. intermedia*, C_3–C_4; *E. curtisi* n.sp., C_5; *E. sulcata*, C_6–Wenlock. *E. hemisphaerica sefinensis* (Williams) and *E. quebecensis* Amos and Boucot are synonyms of *E. hemisphaerica*. All species occur on both sides of the Atlantic. The *Eocoelia* Community in the Welsh Borderland probably occupied a near-shore environment.—V.M.J.

00464 **Zietz, Isidore; Kirby, J. R.** Aeromagnetic and gravity profiles of the United States along the 37th parallel—A contribution to the Upper Mantle Project: U.S. Geol. Survey Geophys. Inv. Map GP-597, scale 1:2,500,000, 1967.

INDEX

[The numbers refer to entries in the abstracts]

Absolute age, dates
Carbon-14
Alberta, Banff National Park, charcoal in volcanic ash: Westgate, J. A. 00377
British Columbia, peat below volcanic ash: Nasmith, H. 00398
California, La Jolla submarine canyon, peat: Dill, Robert F. 10522
Northwest Territories, Baffin Island, Pleistocene plants: Terasmae, J. 10665
Oklahoma, Caddo County, Domebo site, mammoth bone, wood: Leonhardy, Frank C. 10505
Oklahoma, Caddo County, Domebo site, wood: Albritton, Claude C., Jr., 10527
Pollen profile, Sunbeam Prairie bog, Ohio: Kapp, Ronald O. 10466
Yukon, Saint Elias Mts., wood: Denton, George H. 10463
Granitic rocks
Rb–Sr, Ontario, Sudbury area: Hart, S. R. 00614
Igneous rocks
North Carolina, eastern, basement: Denison, Rodger E. 00612
Interpretation
Orogeny age: Gilluly, James. 10381
Metamorphic rocks
North Carolina, eastern, basement: Denison, Rodger E. 00612
Meteorites
K–Ar, Weekeroo Station: Rancitelli, L. 00477
Sedimentary rocks
Floras, Eocene age, western U.S.: Axelrod, Daniel I. 10459
Absolute age, methods
Alpha-recoil track
Description: Huang, W. H. 00499
Carbon-14
Ground water: Pearson, F. J., Jr. 00544
Fluorine
Fossils, analyses methods compared: Egan, Gail N. 10352
Rubidium-strontium
Rb-87, half-life determination: McMullen, C. C. 10649
Thorium-lead
Systematics, Pb–Th–U systems: Steiger, Rudolf H. 10445
Uranium-lead
Systematics, Pb–Th–U systems: Steiger, Rudolf H. 10445
Alabama
Areal geology
Rock Run, Goshen Valley areas: Cloud, Preston E., Jr. 00448
Economic geology
Bauxite, Cherokee, Calhoun, Talladega Counties, occurrence: Denson, Norman M. 10440
Bauxite, kaolin, Rock Run, Goshen Valley areas: Cloud, Preston E., Jr. 00448
Petrology
Ashland Plateau, Hillabee Schist, redefined: Carrington, Thomas J. 00442
Alabama
Stratigraphy
Ashland Plateau, Hillabee Schist, redefined: Carrington, Thomas J. 00442
Paleozoic, Ashland–Talladega Groups, altered facies: Carrington, Thomas J. 00442
Alaska
Earthquakes
July–Aug. 1965, Katmai National Monument: Ward, Peter. 10607
March 27, 1964, effects, Eklutna Hydroelectric Project: Logan, Malcolm H. 00340
March 28, 1964, focal mechanism: Stauder, William. 10597
March 27, 1964, vertical movement: Malloy, R. J. 10528
Economic geology
Coal, resources: Barnes, Farrell F. 00450
Engineering geology
Land subsidence, Kenai Peninsula, Homer spit, 1964 earthquake: Gronewald, Gail J. 10578
Materials, properties, Bootlegger Cove clay, vane shear tests: Sibley, E. A. 10409
Geochemistry
Southeastern coast, sea water, silicate dissolution: Sharma, G. D. 10539
Southeastern, Taku estuary, clay minerals, exchangeable cations: Knowles, L. I. 10541
Geomorphology
Nuka Bay area, glacial-marine features: vonHuene, Roland. 10483
Geophysical surveys
Nuka Bay area, seismic: vonHuene, Roland. 10483
Glacial geology
Nuka Bay area, submarine features: vonHuene, Roland. 10483
Maps, geologic
Gulf of Alaska Tertiary province: Plafker, George. 00452
Southeastern: Brew, D. A. 10618
Marine geology
Nuka Bay area, glacial effects: vonHuene, Roland. 10483
Paleontology
Cephalopoda, Pelecypoda, Cretaceous, Matanuska Formation: Jones, David L. 00341
Mammalia, Pleistocene, Fairbanks area, fossil preservation: Guthrie, R. D. 00310
Mammalia, Pleistocene, Lost Chicken Creek, cat jaw: Whitmore, Frank C., Jr. 00311
Ostracoda, Pleistocene, generic assignments: Schmidt, Ruth A. M. 00609
Stratigraphy
Cambrian–Ordovician, east-central: Brabb, Earl E. 00343
Cretaceous, Matanuska Formation, southern: Jones, David L. 00341
Mesozoic–Tertiary, Gulf of Alaska Tertiary province, tables: Plafker, George. 00452
Pleistocene, interglacial marine, correlation: Flint, Richard Foster. 10474

Alaska
Structural geology
Aleutian arc, tectonics: Perry, Richard B. 10531
Kodiak Island Prince William Sound, faulting, mechanism, 1964: Stauder, William. 10597
Yukon Flats, Tintina fault zone: Roddick, J. A. 00432
Volcanology
Katmai National Monument, July–Aug. 1965, activity: Ward, Peter. 10607

Alberta
Absolute age
Banff National Park, charcoal, C-14: Westgate, J. A. 00377
Economic geology
Petroleum, Athabasca oil sands, evaluation: Fetzner, R. W. 10570
Petroleum, Lloydminster, Wainwright, Chauvin areas, Sparky sand, evaluation: Brown, James S. 10547
Geomorphology
Cypress Hills plateau, periglacial feature, altiplanation surface: Jungerius, P. D. 10589
Geophysical surveys
Lloydminster, Wainwright, Chauvin areas, resistivity and porosity logging: Brown, James S. 10547
Maps, geologic
Ashton Lake Charles Lake Central districts: Godfrey, John D. 10658
Bayonet–Charles Lake North districts: Godfrey, John D. 10658
Potts Lake–Charles Lake South districts: Godfrey, John D. 10658
Rocky Mountain Foothills region: Stott, D. F. 00494
Paleontology
Echinodermata, Mississippian, Banff Limestone, edrioasteroid, new: Kesling, Robert V. 00566
Fauna, Cretaceous, Smoky Group, Rocky Mtn. Foothills: Stott, D. F. 00494
Reptilia, Cretaceous, Edmonton Formation, dinosaur: Langston, Wann, Jr. 00399
Petrology
Banff National Park, volcanic ash layers: Westgate, J. A. 00377
Bayonet, Ashton, Potts, Charles Lakes districts, Precambrian: Godfrey, John D. 10658
Sedimentary petrology
Cypress Hills plateau, Cypress Hills Conglomerate and paleosol: Jungerius, P. D. 10589
Stratigraphy
Cretaceous, Smoky Group, Rocky Mtn. Foothills: Stott, D. F. 00494
Recent, volcanic ash layers, correlation: Westgate, J. A. 00377

Alberta
Structural geology
Bayonet, Ashton, Potts, Charles Lakes districts, Precambrian: Godfrey, John D. 10658
Rocky Mountains, mesoscopic subfabrics, tectonic interpretation: Price, R. A. 00393

Algae
Cambrian
Floras, stratigraphic, geographic distribution: Johnson, J. Harlan. 10453
Quisqualites buckhornensis
Devonian, Oklahoma, Woodford Formation, phylogenetic relations: Wilson, L. R. 00502

Aluminum
Geochemistry
Precipitation by calcium hydroxide, clay mineral catalyst: Singh, S. Shah. 00387
Isotopes
Al 26, Pacific Ocean, sediments: Wasson, John T. 00357

Amphibia
"Baphetes" minor
Pennsylvanian, Nova Scotia, Joggins Formation: Carroll, Robert L. 00532
Calligenethlon watsoni
Pennsylvanian, Nova Scotia, Joggins Formation: Carroll, Robert L. 00532
Dendrerpeton acadianum
Pennsylvanian, Nova Scotia, Joggins Formation: Carroll, Robert L. 00532
Diadectes
Permian, Texas, Arroyo Formation, dentition: Cys, John M. 00535
Labyrinthodontia
Geographic distribution, Carboniferous, Permian: Irving, E. 10479
Geographic distribution, Carboniferous, Permian: Stehli, Francis G. 10480
Pennsylvanian, Nova Scotia, Joggins Formation: Carroll, Robert L. 00532
Morphology
Diadectes, dentition: Cys, John M. 00535

Annelida
Serpuloides
Silurian, nomenclature, addition to treatise: Rhodes, F. H. T. 10471
Spionidae
Devonian, New York, Marcellus Formation: Cameron, Barry. 00410

Anthozoa
Heritschioides
Permian, Nevada, Arcturus Group, new species: Stevens, Calvin H. 00611
Permian
Nevada, Arcturus Group, Leonardian rugose: Stevens, Calvin H. 00611

Archaeocyatha
Acanthopyrgus yukonensis n.gen.n.sp.
Cambrian, Lower, Yukon, Mackenzie Mts.: Handfield, Robert C. 00567

Arizona
Economic geology
Silver, Tombstone: Hewett, D. F. 00401

Arizona
Mineralogy
Meteor Crater area, nickel-iron spherules: Ramdohr, Paul. 10619
Stratigraphy
Pennsylvanian, Paradox basin, nomenclature, revised: Baars, D. L. 00369
Arkansas
Areal geology
Ouachita Mountains, eastern core: Sterling, Philip J. 10646
Ouachita Mountains, flysch facies and structure, guidebook: Kansas Geological Society. 10638
Maps, geologic
Athens plateau, Pike County: Walthall, Bennie H. 10653
Stratigraphy
Carboniferous-Recent, Ouachita Mts.-Arkansas Valley: Stone, Charles G. 10634
Mississippian-Cretaceous, Ouachita Mountains, Athens plateau: Walthall, Bennie H. 10653
Paleozoic, late, Ouachita Mountains, flysch facies: Cline, L. M. 10637
Structural geology
Ouachita Mountains, Athens plateau, anticlines, recumbent: Walthall, Bennie H. 10653
Ouachita Mountains, folds, geometry: Viele, George W. 10635
Ouachita Mountains, regional nappe hypothesis: Viele, George W. 10636
Ouachita Mountains-Arkansas Valley, folds, faults: Stone, Charles G. 10634
Arthropoda
Cretaceous
Texas, Paluxy Formation, Albian conchostracans: Tasch, Paul. 00313
Artifacts
North America
Fluted points, Pleistocene and later cultures: Willey, Gordon R. 10662
Oklahoma
Caddo County, Domebo site, Clovis projectile points: Leonhardy, Frank C. 10505
Associations
American Association Petroleum Geologists
Annual meeting, keynote address, 1966: Croneis, Carey. 00331
Annual meeting, presidential address, 1966: Childs, Orlo E. 00332
American Society for Testing and Materials
Symposium, 1965: Am. Society for Testing and Materials. 10340
American Water Resources Association
Symposium, salt water-fresh water relationships: Parker, Garald G. 10500
Internat. Inst. Seismology and Earthquake Eng.
History: Kisslinger, Carl. 00507
Kansas Geological Society
Field conference guidebook, Ouachita Mts. 1966: Kansas Geological Society. 10638
Associations
National Bureau of Standards
Contributions to geophysics: Baker, Don. 10388
Asterozoa
Archaeophiomusium burrisi, n. gen.
Permian, Oklahoma, Cottonwood Limestone: Hattin, Donald E. 00381
Ophiuroidea
Permian, Oklahoma, Cottonwood Limestone, n.gen.: Hattin, Donald E. 00381
Atlantic Coastal Plain
Paleontology
Ostracoda, Cretaceous-Eocene, *Repandocosta* n.gen.: Hazel, Joseph E. 00516
Sedimentary petrology
Chesapeake Bay to Hatteras, size distribution, in sea water: Bond, Gerard C. 10621
Atlantic Ocean
Marine geology
Continental shelf and slope, U.S., 1962 investigations: Emery, K. O. 10346
Paleontology
Ostracoda, Recent, northeastern: Hazel, Joseph E. 00548
Atmosphere
Composition
Aerosol particles, nature, sources: Cadle, Richard D. 10629
Experimental studies
Nuclear explosions, pressure wave dispersion: Donn, William L. 00336
Origin
Mechanism: Gulbransen, Earl A. 10392
Primitive
Reducing, temperature, stability against escape: Rasool, S. I. 10391
Automatic data processing
Chemical analysis
Minerals, electron-probe data: Rucklidge, J. 00565
Economic geology
Computer well-data system, case history: Stauft, D. L. 10552
Oil sand evaluation, Alberta, Athabasca sands: Fetzner, R. W. 10570
Engineering geology
Soils tests, laboratory, computer programs: Knodel, Paul C. 10613
Geophysical surveys
Computer analysis, aeromagnetic data: Wold, Richard J. 10345
Hydrogeology
U.S. Geol. Survey, Hydrologic Lab., analyses, rock and soil properties: Morris, D. A. 00353
Paleontology
Shell coiling, geometric analysis: Raup, David M. 00558
Well logging
Computer program, focus log analysis: Zenor, Hughes M. 10560
Interpretation, signal theory: Lindseth, R. O. 10561
Quantitative analysis: Gans, Philip. 10568

Aves
Hesperornis regalis
Cretaceous, Northwest Territories, Anderson River bank: Russell, Dale A. 00409
Bacteria
Actinomycetes
Precambrian, Canada, Cobalt Series: Jackson, Togwell A. 00476
Bahamas
Marine geology
Sediments, Tongue of the Ocean, penetration strength tests: Rucker, James B. 00445
Paleontology
Palynomorphs, Quaternary, Great Bahama Bank, surface sediments: Traverse, Alfred. 10511
Sedimentary petrology
Great Bahama Bank, sedimentation, microfossil clues: Traverse, Alfred. 10511
Barite
Geochemistry
Mineralization controls: Dunham, A. C. 00404
Basins, structural
California
Santa Catalina basin: Gaal, Robert A. P. 10523
Bauxite
Alabama
Cherokee, Calhoun, Talladega Counties, occurrence: Denson, Norman M. 10440
Rock Run, Goshen Valley areas, occurrence, reserves: Cloud, Preston E., Jr. 00448
Jamaica
Genesis, mineralogy: Ahmad, N. 10400
Bibliography
Canada
Geography theses, 1963–65: Meyer, W. C. 10603
General
Paperback books, earth science: Proctor, Cleo V., Jr. 00514
Kentucky
Petroleum, natural gas: Howell, Paul. 10434
Rift valleys
World system: Fox, P. J. 10661
Rock deformation
Experimental, supplement: Riecker, R. E. 10614
Biography
Guillou, Robert Barton: Norris, Robert M. 00372
Horton, Harold Merritt: Engel, Noel W. 00373
Leach, Thomas Witt: Jones, C. T. 00374
McNeely, Robert Barnes: Parker, Everett C. 00375
Nichols, Ralph Gregory: Voight, Harold. 00552
Suffield, Harry F.: Curtis, Larry W. 00360
Weichbrodt, Harold T.: Ardmore Geological Society. 10640
Bitumens
Properties
Physical, chemical, Utah: Kayser, Robert B. 10358
Bitumens
Utah
Asphalt Ridge, occurrence: Kayser, Robert B. 10358
Blastoidea
Costatoblastus sappingtonensis n.gen. n.sp.
Mississippian, Montana, Sappington Formation, southwestern: Sprinkle, James. 00622
Brachiopoda
Acanthocrania spinosa n.sp.
Mississippian, Montana, Sappington Formation: Rodriguez, Joaquin. 00606
Beecheria paraplicata n.sp.
Mississippian, Montana, Sappington Formation: Rodriguez, Joaquin. 00606
Chonetes
Devonian, New York, Onondaga Limestone, pink coloration: Zenger, Donald H. 00533
Devonian
Montana, Sappington Formation, western: Rodriguez, Joaquin. 00606
Diceromyonia ignota
Ordovician, Nevada, Ely Springs Dolomite, description: Howe, Herbert J. 00605
Eocoelia
Silurian, North America, cf. Europe, evolving lineage: Ziegler, A. M. 10549
Hypsiptycha cf. H. anticostiensis
Ordovician, Nevada, Ely Springs Dolomite, description: Howe, Herbert J. 00605
Lepidocyclus capax
Ordovician, Nevada, Ely Springs Dolomite, description: Howe, Herbert J. 00605
Mississippian
Montana, Sappington Formation, western: Rodriguez, Joaquin. 00606
Ordovician
Nevada, Ely Springs Dolomite, Pahranagat Range: Howe, Herbert J. 00605
Silurian
New York, Rondout Formation, fauna, correlation: Hoar, Florence Grosvenor. 00557
Branchiopoda
Quaternary
Nevada, Humboldt Formation, freshwater fauna: Dickinson, Kendell A. 00621
British Columbia
Absolute age
South-central, peat, C-14: Nasmith, H. 00398
Maps, geologic
Rocky Mountain Foothills region: Stott, D. F. 00494
Paleoclimatology
Tertiary, Skonun Formation, Queen Charlotte Islands: Martin, Helene A. 10647
Paleontology
Fauna, Cretaceous, Smoky Group, Rocky Mtn. Foothills: Stott, D. F. 00494
Palynomorphs, Tertiary, Skonun Formation, Queen Charlotte Islands: Martin, Helene A. 10647

British Columbia
Stratigraphy
Cretaceous, Smoky Group, Rocky Mtn. Foothills: Stott, D. F. 00494
Recent, Bridge River ash, distribution, age relations: Nasmith, H. 00398
Structural geology
Rocky Mountains, mesoscopic subfabrics, tectonic interpretation: Price, R. A. 00393
Bryozoa
Domopora?
Permian, Texas, referred to *Girtypora and Girtyporina*, n.gen.: Morozova, I. P. 10592
Girtyporidae, n.fam.
Permian, Texas, Guadalupian, new genera for *Domopora?*: Morozova, I. P. 10592
Prasopora
Ordovician, United States, Ontario, evolution: Ross, June Phillips. 00623
Taxonomy
Cryptostomata, new suborder Timanodictyoidea, Permian: Morozova, I. P. 10592
Calcium
Analysis
Atomic absorption spectroscopy, carbonate, silicate rocks: Galle, O. Karmie. 00526
California
Absolute age
La Jolla submarine canyon, peat, C-14: Dill, Robert F. 10522
Areal geology
Devil Canyon–Bear Canyon primitive area: Crowder, Dwight F. 00333
Earthquakes
June 28–29, 1966, Parkfield area, San Andreas fault: Morrison, P. W. 10599
September 12, 1966, Truckee area, effects: Kachadoorian, Reuben. 00355
Economic geology
Mineral resources, Devil Canyon–Bear Canyon primitive area: Crowder, Dwight F. 00333
Engineering geology
Shorelines, central coast, sediment movement, nearshore: Johnson, J. W. 10575
Shorelines, littoral processes: Inman, Douglas L. 10574
Soils, San Francisco Bay mud, shear strength: Boitano, J. D. 10342
Soils, San Francisco Bay mud, shear strength: Miller, E. A. 10410
Geomorphology
Kings Canyon, Tehipite Valley, similarity to Yosemite: Rose, Robert H. 10620
La Jolla submarine canyon, erosion: Dill, Robert F. 10522
Geophysical surveys
Crustal studies, seismic, large scale array: McEvilly, T. V. 10383
Northern, San Andreas fault, seismic: Curray, Joseph R. 00440
Maps, geologic
Deadman Lake quadrangle: Dibblee, T. W., Jr. 00470
California
Maps, geologic
Devil Canyon–Bear Canyon primitive area: Crowder, Dwight F. 00333
Emerson Lake quadrangle: Dibblee, T. W., Jr. 00547
Ludlow quadrangle: Dibblee, T. W., Jr. 00350
San Jose sheet: Rogers, Thomas H. 10596
Mineralogy
Newberyite, monetite, Mono Lake, replacement of struvite: Cohen, Lewis H. 10424
Paleontology
Foraminifera, Miocene, upper, new genus, family: Lipps, Jere H. 00383
Sedimentary petrology
White Mountains, Birch Creek, travertine deposition: Slack, Keith V. 00342
Stratigraphy
Emerson Lake quadrangle: Dibblee, T. W., Jr. 00547
Mesozoic–Cenozoic, Ludlow quadrangle: Dibblee, T. W., Jr. 00350
Paleozoic(?)–Cenozoic, Deadman Lake quadrangle: Dibblee, T. W., Jr. 00470
Paleozoic–Recent, San Jose sheet, nomenclature chart: Rogers, Thomas H. 10596
Structural geology
Central, crust, regional variations: McEvilly, T. V. 10383
Faults, rift system, bibliography: Fox, P. J. 10661
Point Arena–Shelter Cove area, San Andreas fault: Curray, Joseph R. 00440
Santa Catalina basin: Gaal, Robert A. P. 10523
Cambrian
Alaska
East-central, stratigraphy: Brabb, Earl E. 00343
General
Algae, floras, stratigraphic, geographic distribution: Johnson, J. Harlan. 10453
North America
Eastern, Lower, Trilobita, agnostids: Rasetti, Franco. 00531
Oklahoma
Wichita Mountains, granite–rhyolite comagmatic series: Merritt, C. A. 00501
Texas
Central, Wilberns Formation, Trilobita: Winston, Don. 00559
Utah
Western, Middle, Trilobita, *Bathyuriscus*, ontogeny: Robison, Richard A. 00506
Yukon
Mackenzie Mountains, Archaeocyatha: Handfield, Robert C. 00567
Canada
Areal geology
General: Harrison, J. M. 10602

Canada
Economic geology
Mineral exploration, Precambrian Shield, general problems: Lehnert–Thiel, Klaus. 00429
Vanadium, occurrence, potential, chemical field test: Rose, E. R. 00495
Engineering geology
Clays, Leda and varved, shear strength: Eden, W. J. 10350
General
Bibliography, geography theses, 1963–65: Meyer, W. C. 10603
Exploration, Canadian Shield, northern: Wright, G. M. 10664
Geophysical activities, 1966: Garland, G. D. 10593
Geochemistry
Eastern, podzol soils, Cu and Mo, relation to soil properties: Gupta, Umesh C. 10423
Geomorphology
Gulf of St. Lawrence, southern, sea-floor features: Loring, D. H. 10594
Geophysical surveys
Electrical, airborne, overburden mapping, Geol. Survey: Collett, L. S. 10444
Northern, well logging, problems: Nelner, S. H. 10566
Review, 1966: Garland, G. D. 10593
Shield area, structural trends: Domzalski, W. 10395
Glacial geology
Gulf of St. Lawrence, southern, sea-floor features: Loring, D. H. 10594
Marine geology
Geomorphology, Gulf of St. Lawrence, southern: Loring, D. H. 10594
Paleontology
Bacteria, Precambrian, Cobalt Series: Jackson, Togwell A. 00476
Devonian, western, correlation, hemeral scheme: Crickmay, C. H. 10608
Microfossils, Precambrian, iron formations: LaBerge, Gene L. 00435
Stratigraphy
Devonian, western, correlation, hemeral scheme: Crickmay, C. H. 10608

Carbon
Isotopes
C-13, marine dolomite, unusual composition: Russell, K. L. 00359

Carboniferous
Arkansas
Ouachita Mountains–Arkansas Valley, stratigraphy: Stone, Charles G. 10634

Caribbean region
Paleontology
Ostracoda, Tertiary, species distribution, stratigraphic value: Bold, W. A. van den. 10359
Stratigraphy
Tertiary, ostracode distribution, local value: Bold, W. A. van den. 10359

Cartography
Methods
Structural geology, mean-dip maps: Greenwood, W. R. 00484

Central America
Geomorphology
Landforms, volcanic, types: Weyl, Richard. 10415
Volcanology
Landforms, relation to magma type: Weyl, Richard. 10415

Cephalopoda
Ammonoidea
Cretaceous, Alaska, Matanuska Formation, southern: Jones, David L. 00341
Morphology, planispiral coiling, geometric analysis: Raup, David M. 00558
Aulacocerida
Taxonomy, morphology, phylogeny: Jeletzky, J. A. 10472
Belemnitida
Taxonomy, morphology, phylogeny: Jeletzky, J. A. 10472
Buelowiteuthis, n.gen.
Triassic, diagnosis: Jeletzky, J. A. 10472
Clistoceras globosum, n.gen., n.sp.
Pennsylvanian, Northwest Territories, Ellesmere Island, morphology: Nassichuk, W. W. 00522
Coleoidea
Taxonomy, morphology, phylogeny: Jeletzky, J. A. 10472
Groenlandibelus, n.gen.
Cretaceous, Upper, diagnosis: Jeletzky, J. A. 10472
Moisisovicsteuthis, n.gen.
Triassic–Jurassic, diagnosis: Jeletzky, J. A. 10472
Morphology
Ammonitida, Stephanoceratacea, umbilical lobe: Westermann, G. E. G. 00523
Goniatitida, *Clistoceras*, helicolateral deposits: Nassichuk, W. W. 00522
Phragmoteuthida
Taxonomy, morphology, phylogeny: Jeletzky, J. A. 10472
Septida
Taxonomy, morphology, phylogeny: Jeletzky, J. A. 10472
Stephanoceratacea
Morphology of umbilical lobe: Westermann, G. E. G. 00523
Teuthida
Taxonomy, morphology, phylogeny: Jeletzky, J. A. 10472

Ceramic materials
Illinois
Eastern, clay and shale, potential: White, W. Arthur. 00520

Changes of level
California
La Jolla submarine canyon: Dill, Robert F. 10522

Changes of level
Correlation
Pleistocene, Virginia, Alaska, cf. Mediterranean: Flint, Richard Foster. 10474
Hawaii
Cenozoic, drowned terraces, Pliocene?–Recent: Holden, John C. 00347
Quaternary
New England, continental shelf evidence: Garrison, Louis E. 10482
Chemical analysis
Computer technique
Minerals, electron probe data: Rucklidge, J. 00565
General
Fluorine, fossils, methods compared: Egan, Gail N. 10352
Wet
Carbonate, silicate rocks, adaption to atomic absorption: Galle, O. Karmie. 00526
Clay mineralogy
Areal studies
Alaska, Taku estuary, sediments: Kunze, G. W. 10540
Georgia, granitic rocks, weathering profiles: Harriss, Robert C. 10374
North Dakota, eastern, Chernozem soils: Redmond, C. E. 00318
Oklahoma, granitic rocks, weathering profiles: Harriss, Robert C. 10374
Pacific Ocean, sediments: Gorbunóva, Z. N. 10533
Experimental studies
Adsorption, fluoride: Bower, C. A. 00386
Biotite alteration, chemical and biological: Boyle, J. R. 00358
Cesium sorption by illite, montmorillonite, vermiculite: Sawhney, B. L. 10362
Equilibrium relations, environment of stability: Hess, Paul C. 10355
Equilibrium with ocean water: MacKenzie, Fred T. 10461
Hematite, water adsorption, anion effects: Jurinak, J. J. 10364
Montmorillonite, adsorption, s-triazine compounds: Weber, J. B. 10421
Surface acidity, determination, infrared spectroscopy: Harter, Robert D. 00316
Mineral data
Allophane, genesis from kaolinitic nodules, Missouri: Keller, W. D. 00608
Bentonite, ion exchange: Carlson, R. M. 00389
Montmorillonite, adsorption, s-triazine compounds: Weber, J. B. 10421
Clays
Alabama
Cherokee, Calhoun, Talladega Counties, pisolitic, occurrence: Denson, Norman M. 10440
Engineering properties
Shear strength, Bootlegger Cove clay, Alaska: Sibley, E. A. 10409
Clays
Engineering properties
Shear strength, field vane test, evaluation: Eden, W. J. 10350
Shear strength, inspection vane borer: Andresen, A. 10411
Kentucky
Cayce quadrangle, resources: Olive, Wilds W. 00539
Lexington West quadrangle, resources: Miller, Robert D. 00471
Coal
Alaska
Resources: Barnes, Farrell F. 00450
Colorado
Oh-be-joyful quadrangle, resources: Gaskill, David L. 00607
Geochemistry
Analyses, uses, limitations: Rees, O. W. 00515
Illinois
Coking properties: Jackman, H. W. 00521
Texas
North-central, southern, resources: Mapel, W. J. 00334
Utah
Resources, southwestern: Grose, L. T. 00619
Colorado
Economic geology
Mineral resources, Oh-be-joyful quadrangle: Gaskill, David L. 00607
Geochemistry
Cripple Creek district, geochemical prospecting: Gott, Garland B., Jr. 00454
Geomorphology
Western, rock creep rates: Schumm, S. A. 00400
Maps, geologic
Oh-be-joyful quadrangle: Gaskill, David L. 00607
Mineralogy
Aquamarine, composition, Mount Antero: Radcliffe, Dennis. 10446
Sedimentary petrology
Red beds, Paleozoic sequence: Walker, Theodore R. 00437
Stratigraphy
Pennsylvanian, Paradox basin, nomenclature, revised: Baars, D. L. 00369
Pennsylvanian–Quaternary, Oh-be-joyful quadrangle, sections: Gaskill, David L. 00607
Connate water
Composition
Petroleum-bearing formations, classification: Ostroff, A. G. 00563
Connecticut
Economic geology
Construction materials, Uncasville quadrangle, use: Goldsmith, Richard. 00564
Mineral resources, New London quadrangle, use: Goldsmith, Richard. 00348
Mineral resources, Niantic quadrangle, use: Goldsmith, Richard. 00349

Connecticut
Maps
Geologic, Uncasville quadrangle: Goldsmith, Richard. 00564
Maps, geologic
New London quadrangle: Goldsmith, Richard. 00348
Niantic quadrangle: Goldsmith, Richard. 00349
Petrology
Southeastern, Ordovician schist, metamorphism: Lundgren, L. W., Jr. 10484
Stratigraphy
Paleozoic, New London quadrangle, section, pre-Silurian–Pennsylvanian: Goldsmith, Richard. 00348
Paleozoic, Niantic quadrangle, section, pre-Silurian–Pennsylvanian: Goldsmith, Richard. 00349
Paleozoic, Uncasville quadrangle, pre-Silurian–Pennsylvanian, sections: Goldsmith, Richard. 00564
Conodonts
Bibliography
Review of literature 1958–65: Rhodes, F. H. T. 10471
Mississippian
Kansas, northwestern, age span: Goebel, Edwin D. 00528
Ordovician
Nevada, Muddy Mountains, Monocline Valley Formation: Longwell, Chester R. 00439
Taxonomy
Treatise, additions: Rhodes, F. H. T. 10471
Construction materials
Connecticut
Uncasville quadrangle, use: Goldsmith, Richard. 00564
Indiana
Salem Limestone, dimension stone: Rooney, Lawrence F. 10612
Properties
Aggregate, surface charges: Crenshaw, A. B. 10666
Tennessee
Graves Spring quadrangle, resources: Larson, Lawrence T. 10571
Continental margin
Pacific Ocean
California, San Andreas fault, seismic survey: Curray, Joseph R. 00440
California, Santa Catalina basin, structure: Gaal, Robert A. P. 10523
Rise
Evolution: Heezen, Bruce C. 10525
Continental shelf
Atlantic Ocean
New England, southern, sediments, geomorphology: Garrison, Louis E. 10482
Newfoundland, structures, lithology: Lilly, H. D. 10478
Continental shelf
Atlantic Ocean
North Carolina, Cape Fear area, phosphatic sand deposit: Pilkey, Orrin H. 00441
United States, 1962 investigations, summary: Emery, K. O. 10346
Gulf of Mexico
Florida, seismic, magnetic surveys, core data: Antoine, John. 00361
Pacific Ocean
Alaska, Kenai Peninsula, glacial-marine geology: vonHuene, Roland. 10483
California, La Jolla canyon, erosion, age: Dill, Robert F. 10522
Continental slope
Atlantic Ocean
United States, 1962 investigations, summary: Emery, K. O. 10346
General
Evolution: Terry, Richard D. 10524
Gulf of Mexico
Florida, seismic, magnetic surveys, core data: Antoine, John. 00361
Continents
Evolution
Outward growth: Skehan, James W. 10403
Copper
Geochemistry
Soils, Canada, eastern: Gupta, Umesh C. 10423
Kansas
South-central, Wellington Formation, exploration, analyses: Hill, Walter E., Jr. 00527
Correlation
Methods
Devonian System, western Canada: Crickmay, C. H. 10608
Permian
Utah: Vaughn, Peter Paul. 00323
Principles
Devonian System, western Canada: Crickmay, C. H. 10608
Cretaceous
Alaska
Southern, Matanuska Formation: Jones, David L. 00341
Alberta
Drumheller area, Edmonton Formation, Reptilia: Langston, Wann, Jr. 00399
Rocky Mountain Foothills, Smoky Group, faunal assemblage: Stott, D. F. 00494
Atlantic Coastal Plain
Ostracoda, Upper, *Repandocosta* n.gen.: Hazel, Joseph E. 00516
British Columbia
Rocky Mountain Foothills, Smoky Group, faunal assemblage: Stott, D. F. 00494
Gulf Coastal Plain
Ostracoda, Upper, *Repandocosta* n.gen.: Hazel, Joseph E. 00516
Idaho
Bonner County, Kaniksu batholithic complex: Savage, C. N. 00418

Cretaceous
Montana
Foraminifera, Belle Fourche Shale: Eicher, Don L. 00312
North Dakota
South-central, Fox Hills Formation, Echinoidea: Holland, F. D., Jr. 00534
Northwest Territories
Anderson River bank, Vertebrata, fauna: Russell, Dale A. 00409
Texas
Glen Rose Limestone, Echinoidea, descriptions, new species: Whitney, Marion I. 10428
Paluxy Formation, Arthropoda: Tasch, Paul. 00313
Trinidad
Biostratigraphy, Foraminifera, correlation: Bolli, Hans M. 10495
Utah
Asphalt Ridge area, stratigraphy: Kayser, Robert B. 10358
West Indies
Bonaire, Washikemba formation: Beets, D. J. 00365
Wyoming
Foraminifera, Belle Fourche Shale: Eicher, Don L. 00312
Crinoidea
Botryocrinus niemani n.sp.
Devonian, Ohio, Silica Formation: Kesling, Robert V. 10657
Crust
California
Structure, central: McEvilly, T. V. 10383
Genesis
Continental, United States, northwestern: Skehan, James W. 10403
North America
Precambrian, composition: Condie, Kent C. 00620
Oregon
Thickness, refraction profile: Berg, Joseph W., Jr. 10360
Physical properties
Electrical properties: Keller, G. V. 10393
Structure
Model, geophysical determination: Linehan, Daniel. 10348
Thickness
Model, geophysical determination: Linehan, Daniel. 10348
World averages: Lee, W. H. K. 10382
United States
Electrical properties: Keller, G. V. 10393
Pacific Northwest, Olympic-Wallowa lineament, continental-oceanic boundary: Skehan, James W. 10403
Crystal chemistry
Andalusite
Fe^{+3}, electron spin resonance spectra: Holuj, F. 10650
Barium
Partition, magmas: Dunham, A. C. 00404
Crystal chemistry
Beryl
Cell dimension variations with composition: Radcliffe, Dennis. 10446
Chlorite
Al-Si ordering: Fujii, Takashi. 00555
Colemanite
Nonpolar and ferroelectric phases: Hainsworth, F. N. 10644
Cordierite
Fe^{+3}, electron spin resonance spectra: Hedgecock, N. E. 10632
Dolomite
Growth of crystals: Peterson, M. N. A. 10376
Muscovite
Al-Si, long-range order: Fujii, Takashi. 00555
Pyromorphite
Synthetic: Baker, W. E. 10426
Tin apatite
Synthesis, X-ray diffraction data: McConnell, Duncan. 10667
Zellerite
Dehydration to metazellerite: Coleman, R. G. 10420
Crystal structure
Colemanite
Nonpolar and ferroelectric phases: Hainsworth, F. N. 10644
Newberyite
California, Mono Lake: Cohen, Lewis H. 10424
Pyromorphite
Synthetic: Baker, W. E. 10426
Deformation
Experimental studies
Bibliography, supplement: Riecker, R. E. 10614
Strength, in-situ measurement, photoelastic strain gage: Voight, Barry. 00431
Field studies
Mechanism, Cordilleran infrastructure, U.S., Great Basin: Armstrong, Richard Lee. 10369
Strength, in-situ measurement, photoelastic strain gage: Voight, Barry. 00431
Mechanism
Recrystallization, model study: Devore, George W. 10625
Delaware
Sedimentary petrology
Delaware River estuary, sediments, suspended pollen-mineral ratio: Groot, Johan J. 10512
Devonian
Canada
Western, correlation, principles, methods: Crickmay, C. H. 10608
Montana
Western, Brachiopoda, Sappington Formation, correlation: Rodriguez, Joaquin. 00606
New York
Central, Onondaga Limestone, Brachiopoda, pink *Chonetes*: Zenger, Donald H. 00533
Western, paleogeography, Late: Colton, George W. 00553

Devonian
Ohio
Silica Formation, Crinoidea, new species: Kesling, Robert V. 10657
Oklahoma
Woodford Formation, algae: Wilson, L. R. 00502
Diagenesis
Carbonate rocks
Marine environment: Sander, N. J. 00366
Carbonate sediments
Sediment–seawater system, equilibrium texture model: Schmalz, Robert F. 10534
Carbonate shells
Mytilus, minor alterations, evaluation: Dodd, J. R. 10536
Shale
Kaolinitic nodules, alteration to allophane, alunite: Keller, W. D. 00608
Diapirs
Texas
Live Oak, McMullen Counties, Gueydan Formation: Freeman, Paul S. 00551
Earth
Composition
Geochemical differentiation, morphologic entities: Gheith, Mohamed A. 10404
Evolution
Endospheres, interzonal coupling: Fairbridge, Rhodes W. 10492
Relation to Moon capture: Szasz, S. E. 10405
General
Textbook: Dunbar, Carl O. 10449
Interior
Mantle–core boundary, nature: Kanamori, Hiroo. 00380
Shape
Topography, spherical harmonic analysis: Lee, W. H. K. 00425
Earth–current methods
Experimental studies
Plane-wave analog model: Dosso, H. W. 10645
Earthquakes
Alaska
July–Aug. 1965, Katmai National Monument: Ward, Peter. 10607
March 27, 1964, effects, Eklutna Hydroelectric Project: Logan, Malcolm H. 00340
March 28, 1964, focal mechanism: Stauder, William. 10597
March 27, 1964, vertical movement: Malloy, R. J. 10528
California
June 28–29, 1966, Parkfield area, San Andreas fault: Morrison, P. W. 10599
September 12, 1966, Truckee area, effects: Kachadoorian, Reuben. 00355
Effects
Vertical movement, Alaska, March 1964: Malloy, R. J. 10528
Mechanisms
Alaska, March 28, 1964: Stauder, William. 10597
Earthquakes
Mexico
May 11, 19, 1962, Acapulco, ground motion effects: Binder, Reuben W. 10436
Echinodermata
Edrioasteroidea
Families, key: Kesling, Robert V. 00566
Lispidecodus plinthotus n.gen. n.sp.
Mississippian, Alberta, Banff Limestone(?): Kesling, Robert V. 00566
Pyrgocystidae n.fam.
Mississippian, Alberta, Banff Limestone(?), edrioasteroid: Kesling, Robert V. 00566
Triamara cutleri n.gen. n.sp.
Silurian, Indiana, Osgood Formation, cystoid: Tillman, C. G. 00568
Echinoidea
Cretaceous
Texas, Glen Rose Limestone, descriptions, new: Whitney, Marion I. 10428
Hardouinia waagei n.sp.
Cretaceous, North Dakota, Fox Hills Formation, cassiduloid: Holland, F. D., Jr. 00534
Ecology
California
Fluviatile, travertine deposition, Inyo County: Slack, Keith V. 00342
Ostracoda
Marine, Mexico: McKenzie, K. G. 00390
Marine, Mexico: Swain, Frederick M. 00391
Vertebrata
Fluvial environment, South Dakota: Bjork, Philip R. 00536
Education
Engineering geology
Earthquakes, International Institute, history: Kisslinger, Carl. 00507
Environmental geology
Curricula, need for courses: Flawn, Peter T. 00508
General
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Geophysics
Field course, GSI Student Cooperative Plan: Shrock, Robert R. 10651
Physical geology
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International Institute, history: Kisslinger, Carl. 00507
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Methods, field trip substitute: Tomikel, John. 00513
Structural geology
Materials, stereonet, construction: Dunn, David E. 00511

Education
Structural geology
Smith College, sand models: Schalk, Marshall. 00512
Elastic properties
Mantle
Seismic wave attenuation, interpretation: Gordon, Robert B. 10343
Rocks
Determination in situ: Voight, Barry. 00431
Electrical methods
Applications
Water-well logging, interpretation: Guyod, Hubert. 10397
Electromagnetic
Airborne, resistivity contrasts, overburden, Geol. Survey Canada: Collett, L. S. 10444
Experimental studies
Sandstone, induced polarization: Schoeppel, R. J. 10562
Induced polarization
Sandstone, salinity and shalyness effects: Schoeppel, R. J. 10562
Interpretation
Spectral analysis: Hannan, E. J. 10384
Resistivity
Experimental study, pressure and temperature effect: Helander, Donald P. 10565
Techniques
Induced Pulse Transient, airborne, overburden mapping, Canada: Collett, L. S. 10444
Electrical properties
Crust
United States: Keller, G. V. 10393
Mantle
United States: Keller, G. V. 10393
Electrical surveys
Maine
Island Falls quadrangle, electromagnetic, bedrock: Ekren, E. B. 00339
United States
Denver basin, logging, correlation with geology: Keller, George V. 10567
Electron microscopy
Data
Algae, wall structure: Wilson, L. R. 00502
Elements
Abundance
Estimation, computation methods: Miesch, A. T. 00459
Rock bodies, spatial variation, theory of error: Miesch, A. T. 00345
Engineering geology
Applications
Petroleum reservoir analysis: Havlena, D. 10551
Clays
Shear strength, field vane test, evaluation, Canada: Eden, W. J. 10350
Shear strength, inspection vane borer, Norwegian: Andresen, A. 10411
Swelling, experimental study: McNeal, B. L. 10443
Engineering geology
Dams
Rockfill materials, Mexico, strength tests: Marsal, Raul J. 00498
Earthquakes
Education, International Institute, history: Kisslinger, Carl. 00507
Mexico, Acapulco, May 1962, ground motion effects: Binder, Reuben W. 10436
Experimental studies
Beach erosion, non-breaking waves: Herbich, John B. 10580
Clay sediments, pore-water flow, thermal influence: Paaswell, Robert E. 00545
Clays, swelling, solution composition, effect: McNeal, B. L. 10443
Frozen clay soils, stress effect on creep rates: Andersland, O. B. 00540
Foundations
Kentucky, Lexington West quadrangle: Miller, Robert D. 00471
Soils, penetration resistance, testing, portable penetrometer: Sowers, George F. 10341
Soils, shear strength, vane shear device: Sibley, E. A. 10409
Techniques, soils, vane-shear and cone-penetration: Am. Society for Testing and Materials. 10340
Highways
Aggregate, surface charges: Crenshaw, A. B. 10666
Land subsidence
Alaska, Kenai Peninsula, Homer spit, 1964 earthquake: Gronewald, Gail J. 10578
Materials, properties
Jamaica, limestones, soft: Tubey, L. W. 10656
Rockfill, laboratory tests, Mexico: Marsal, Raul J. 00498
Soils, shear strength, vane tests: Boitano, J. D. 10342
Soils, shear strength, vane tests, field vs. laboratory: Miller, E. A. 10410
Soils tests, laboratory, computer programs: Knodel, Paul C. 10613
Rock mechanics
Experimental deformation, bibliography, supplement: Riecker, R. E. 10614
Fracturing under impulsive loading: Rinehart, John S. 10450
Photoelastic strain gage, field use: Voight, Barry. 00431
Seepage
Petroleum and salt industry operations, ground-water: Foley, Frank C. 10502
Shorelines
Alaska, Kenai Peninsula, Homer spit, earthquake subsidence, erosion: Gronewald, Gail J. 10578
Beach erosion, bypassing and backpassing: Bruun, P. M. 10576
Beaches, erosion, oscillatory water particle motion, experimental study: Herbich, John B. 10580

Engineering geology
Shorelines
Beaches, estuaries, processes: Johnson, J. W. 10451
California, central coast, sediment movement, nearshore: Johnson, J. W. 10575
Littoral processes, working hypothesis: Inman, Douglas L. 10574
Oregon, Clatsop Beach, accretion and erosion, history: Kidby, Harold A. 10577
Soils
Frozen clay, stress effect on creep rates, experimental: Andersland, O. B. 00540
Laboratory tests, computer programs: Knodel, Paul C. 10613
Moisture, post-infiltration redistribution, hysteresis effects: Rubin, J. 00315
Moisture-strength relations, trafficability: Bassett, J. R. 00320
Shear strength, California, San Francisco Bay mud: Miller, E. A. 10410
Soil-water system, water definition concepts: Arigos, Luis Eduardo. 10344
Submarine installations
Pipelines, marine studies for design and construction: Miller, David R. 10581
Tsunamis
Hawaii, Hilo harbor, hydraulic model study: Palmer, Robert Q. 10595
Tunnels
Massachusetts, Malden Tunnel: Billings, Marland P. 10353
Waste disposal
Fission products, soils, chelating agents, effects: Nishita, H. 00388
Petroleum and salt industry operations, ground-water contamination, past and present: Foley, Frank C. 10502
Washington-Oregon, Columbia River estuary, radionuclide movement: Prych, Edmund A. 10579
Waterways
Alluvial channels, thalweg profile surveys, equipment improvement: Carey, Walter C. 00415
Erosion
Beaches
Cause, sea-level rise, Bruun's rule: Schwartz, Maurice L. 00542
North Carolina, Bodie Island, seasonal variations in profiles: Dolan, Robert. 10429
Wave action, non-breaking, experimental study: Herbich, John B. 10580
California
La Jolla submarine canyon: Dill, Robert F. 10522
Slopes
Colorado, creep rate, surficial rock: Schumm, S. A. 00400
Streams
Alluvial channels, straight: Maddock, Thomas, Jr. 10590
Estuaries
Sedimentation
Delaware-New Jersey, Delaware River, pollen-mineral ratio: Groot, Johan J. 10512
Processes, materials, engineering problems: Johnson, J. W. 10451
Evaporites
Exploration
General: Goldsmith, Louis H. 10557
Genesis
General: Goldsmith, Louis H. 10557
Evolution
Brachiopoda
Eocoelia, Silurian, North America and Europe: Ziegler, A. M. 10549
Bryozoa
Prasopora, Ordovician, Middle: Ross, June Phillips. 00623
Concepts
Geologic, cosmic cycles, correlation: Fairbridge, R. W. 10494
Graptolithina
North American, British, faunal provinces: Berry, William B. N. 00395
Ostracoda
Hemicytherinae, muscle scar pattern: Hazel, Joseph E. 00548
Pisces
Actinopterygii: Vaughn, Peter Paul. 00323
Bradyodonti, dentition: Berman, David S. 00321
Explosion phenomena
Experimental studies
Atmosphere, pressure wave dispersion: Donn, William L. 00336
Products
Atmospheric dust, nature, sources: Cadle, Richard D. 10629
Faults
Mechanism
Alaska, Kodiak Island-Prince William Sound, 1964 earthquake: Stauder, William. 10597
Imbricate thrusting, Idaho, Illinois Peak area: Nord, Gordon L., Jr. 00490
Overthrust
Arkansas, Ouachita Mountains: Viele, George W. 10636
Idaho, Illinois Peak area: Nord, Gordon L., Jr. 00490
Rocky Mountains, Alberta-British Columbia: Price, R. A. 00393
Patterns
Arkansas, Ouachita Mountains-Arkansas Valley: Stone, Charles G. 10634
Bonner County, Purcell trench: Savage, C. N. 00418
Rift valleys
World system, bibliography: Fox, P. J. 10661
Strike-slip
Alaska-Yukon, Tintina fault zone: Roddick, J. A. 00432
California, San Andreas, movement, June 1966: Morrison, P. W. 10599
California, San Andreas, trace north of Point Arena: Curray, Joseph R. 00440

Florida
Engineering geology
Shorelines, inlets, beach erosion, bypassing and backpassing: Bruun, P. M. 10576
Hydrogeology
Escambia, Santa Rosa Counties, basic data: Musgrove, Rufus H. 10553
Fluid inclusions
Ice
Metastable superheated: Roedder, Edwin. 00411
Folds
Geometry
Fabric analysis, stereographic net, technique: Viele, George W. 10635
Mean-dip maps: Greenwood, W. R. 00484
Recumbent
Arkansas, Ouachita Mountains: Viele, George W. 10636
Arkansas, Ouachita Mountains, Athens plateau: Walthall, Bennie H. 10653
United States, Great Basin, eastern, Cordilleran infrastructure: Armstrong, Richard Lee. 10369
Synclinal
Arkansas, Ouachita Mountains–Arkansas Valley: Stone, Charles G. 10634
Foraminifera
Ammomarginulina paterella n.sp.
Cretaceous, Wyoming–Montana, Belle Fourche Shale: Eicher, Don L. 00312
Cretaceous
Trinidad, planktonic biostratigraphy: Bolli, Hans M. 10495
Wyoming–Montana, Belle Fourche Shale, fauna, environment: Eicher, Don L. 00312
Pennsylvanian
Oklahoma, Atoka Formation, Ouachita Mts., flysch assemblages: Stark, Philip H. 10633
Tertiary
Trinidad, planktonic biostratigraphy: Bolli, Hans M. 10495
Tremachora arga, n.gen., n. sp.
Miocene, California, southern: Lipps, Jere H. 00383
Tremachoridea, n.fam.
Miocene, California, southern: Lipps, Jere H. 00383
Fossils, problematic
Ancientia fortensis n. sp.
Ordovician, Waynesville Formation, Ohio: Ross, June Phillips. 00556
Ancientia ohioensis n. gen. n. sp.
Ordovician, Waynesville Formation, Ohio: Ross, June Phillips. 00556
Ancientidae n. fam.
Ordovician, Upper, Ohio: Ross, June Phillips. 00556
Taxonomy
Treatise, additions: Rhodes, F. H. T. 10471
Fractures
Genesis
Tectonic movements, Rocky Mountains, Alberta–British Columbia: Price, R. A. 00393
Fractures
Joints
Kansas, Pennsylvanian limestones, northeastern, trends: Stewart, Gary F. 00529
Manitoba, Issett Lake map-area, statistical analysis: Bristol, Calvert C. 10347
Gallium
Abundance
Canyon Diablo, Odessa meteorites: Wasson, John T. 00473
Gas, natural
Accumulation
Regional factors: Al-Khersan, Hashim F. 00549
Kentucky
Bibliography, index maps: Howell, Paul. 10434
Oklahoma
Caddo anticline, occurrence, production: Becker, Robert M. 10631
Overbrook anticline: Becker, Robert M. 10654
Gastropoda
Cretaceous
Wyoming, Pierre Shale, Red Bird fauna, taxonomic uniformity: Sohl, Norman F. 00519
Drepanochilus
Cretaceous, Wyoming, evolutionary significance: Sohl, Norman F. 00519
Eotomariidae
Paleozoic, taxonomy, nomenclature: Batten, Roger L. 00524
Ordovician
Michigan, Trentonian limestones, carnivorous, borings: Cameron, Barry. 00322
New York, Trentonian limestones, carnivorous, borings: Cameron, Barry. 00322
Pleurotomariacea
Paleozoic, taxonomy, nomenclature: Batten, Roger L. 00524
Ptychomphalina
Nomenclature, unnecessary eotomariid genus: Batten, Roger L. 00524
Quaternary
Oklahoma, Caddo County, Domebo site, Pleistocene, paleoecology: Cheatum, E. P. 10615
General
Bibliography
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Education
Cultural subject: Hewitt, Philip C. 00509
Environmental geology, curricula, need: Flawn, Peter T. 00508
Laboratory manual and note book: Tomikel, John. 10365
Philosophy
Uniformitarianism, importance in teaching: Hay, Edward A. 00510

General
Practice
Geologist, role in development of energy resources: Croneis, Carey. 00331
Textbooks
Earth: Dunbar, Carl O. 10449
Geochemical prospecting
Nickel
Technique, soils and stream sediments near peridotite: Carpenter, Robert H. 00443
Geochemical surveys
Canada
Podzol soils, eastern: Gupta, Umesh C. 10423
Colorado
Cripple Creek district, gold: Gott, Garland B., Jr. 00454
Kansas
Copper, red beds, south-central: Hill, Walter E., Jr. 00527
North Carolina
Nickel, Democrat area: Carpenter, Robert H. 00443
Geochemistry
Abundance of elements
Barium, western U.S.: Dunham, A. C. 00404
Estimation, computation methods: Miesch, A. T. 00459
Rock bodies, spatial variation, theory of error: Miesch, A. T. 00345
Adsorption
Montmorillonite, *s*-triazine compounds: Weber, J. B. 10421
Aluminum
Precipitation by calcium hydroxide, clay mineral catalyst: Singh, S. Shah. 00387
Basalt
Kilauea Iki crater, Hawaii, 1959 eruption: Murata, K. J. 10371
Crust
Precambrian, North America: Condie, Kent C. 00620
Dissociation
$FeCO_3$ to α-Fe_2O_3, rate: Seguin, Maurice. 10477
Dissolution
Silicon, sea water, Alaska: Sharma, G. D. 10539
Earth
Differentiation, morphologic entities: Gheith, Mohamed A. 10404
Exchange capacity
Clay minerals, cations, Alaska: Knowles, L. I. 10541
Clay minerals, cesium sorption: Sawhney, B. L. 10362
Ground-water and drainage effluents, irrigation areas: Hem, John D. 10487
Ion exchange
Bentonite: Carlson, R. M. 00389
Mafic rocks
Chromian spinels, petrogenetic indicator: Irvine, T. N. 00378
Mass balance
Rivers and oceans: MacKenzie, Fred T. 10461
Geochemistry
Methods
Soil phosphates, fractionation, Wisconsin soils: Petersen, G. W. 10363
Processes
Graphite-hydrogen reactions, importance: Gulbransen, Earl A. 10392
Sea water
Interactions with suspended minerals: Chave, Keith E. 10519
Soils
Loess-derived, phosphorous, Iowa: Runge, E. C. A. 10408
Solubility
Carbonate solids, sea water: Weyl, P. K. 10535
Magnesite-dolomite: Johannes, Wilhelm. 00405
Magnesite-dolomite: Rosenberg, P. E. 00406
Pyrite, chloride solutions: Barnard, Walther M. 00402
Silica, soils: Miller, Raymond W. 00317
SiO_2: Mueller, Robert F. 00543
Sorption
Estuary sediments, Columbia River, Zn-65: Johnson, Vernon. 00325
Geochronology
Principles
Misuse of radiometric ages: Gilluly, James. 10381
Time scales
Cycles, geologic and cosmic, correlation: Fairbridge, R. W. 10494
Geodesy
Figure of Earth
Topography, spherical harmonic analysis: Lee, W. H. K. 00425
Geomorphology
Eolian features
Dunes, New Mexico, Las Cruces area, coppice type on Rotura soil: Gile, Leland H. 10357
Dunes, structures, depositional environment, infrared study: Stanley, Daniel J. 00371
Sand mantle, ventifacts, Massachusetts: Hartshorn, Joseph H. 00449
Fluvial features
Alluvial channels, bed forms, nomenclature: Carey, Walter C. 00415
Alluvial channels, bedforms, sonic-sounder observations: Culbertson, James K. 00414
Erosion, alluvial channels, straight: Maddock, Thomas, Jr. 10590
Erosion, Oklahoma, Domebo Branch of Tonkawa Creek: Retallick, Harold J. 10504
Frost action
Pingos, formation, Northwest Territories: Bostrom, R. C. 00363
Glacial features
Canada, general: Harrison, J. M. 10602
Marine, Alaska, Nuka Bay area: vonHuene, Roland. 10483
Moraines, erosion, Hawaii, Mauna Kea: Wentworth, Chester K. 10447

Geomorphology
Glacial features
Moraines, other deposits, Massachusetts, Taunton quadrangle: Hartshorn, Joseph H. 00449
U-shaped valleys, California, Kings River country: Rose, Robert H. 10620
Landform description
Canada, general: Harrison, J. M. 10602
Landform evolution
Canada, general: Harrison, J. M. 10602
General, Canada, Gulf of St. Lawrence, glacial influence: Loring, D. H. 10594
Massachusetts, Cape Cod, popular account: Strahler, Arthur N. 10438
Mass movements
Altiplanation, Alberta, Cypress Hills plateau: Jungerius, P. D. 10589
Creep rate, surficial rock, Colorado: Schumm, S. A. 00400
Rates, Northwest Territories, Baffin Island, Inugsuin Fiord: Barnett, D. M. 10588
Silurian dolomite, Pleistocene, Ontario, Niagara Escarpment: Straw, Allan. 10587
Periglacial features
Mass movements, Ontario, Meaford area, Niagara Escarpment, cf. England: Straw, Allan. 10587
Pingos, Northwest Territories, Mackenzie Delta area: Mackay, J. Ross. 10586
Quantitative geomorphology
Rivers, network topology, graph theory: Scheidegger, A. E. 00326
Rock creep rates, Colorado: Schumm, S. A. 00400
Valley-side slopes, sampling: Carson, M. A. 00560
Shore features
Beach erosion, cause, Bruun's rule: Schwartz, Maurice L. 00542
Beaches, estuaries, coastal processes, engineering problems: Johnson, J. W. 10451
Fjords, Alaska, Nuka Bay: vonHuene, Roland. 10483
Geophysical methods
Applications
Crustal studies: Linehan, Daniel. 10348
Mineral exploration, drill-hole logging: Zablocki, C. J. 10563
Interpretation
Spectral analysis: Hannan, E. J. 10384
Spherical data, analysis techniques: Kaula, W. M. 00337
Geophysical surveys
Canada
Review, 1966: Garland, G. D. 10593
General
World summary, 1965: Smith, Neal J. 10394
Geophysics
Education
Field course, GSI Student Cooperative Plan: Shrock, Robert R. 10651
Observations
Canada, 1966, review: Garland, G. D. 10593
Geophysics
Practice
National Bureau of Standards, contributions: Baker, Don. 10388
Georgia
Geochemistry
Granitic rocks, mineral stability sequence, weathering: Harriss, Robert C. 10374
Mineralogy
Zeolites, Piedmont crystalline rocks: Ramspott, L. D. 00416
Weathering
Granite: Harriss, Robert C. 10374
Geosynclines
Ouachita
Sedimentation, Mississippian: Johnson, Kent E. 10630
Geothermal energy
Exploration
Temperatures at depth, method: Fournier, R. O. 10476
Germanium
Abundance
Canyon Diablo, Odessa meteorites: Wasson, John T. 00473
Glaciation
Causes
Meteorological aspects, circulation models, Labrador-Ungava area: Barry, R. G. 10584
Erosion
Granite valleys, California, Kings Canyon, Tehipite Valley: Rose, Robert H. 10620
Ice movements
Cordilleran Ice Sheet, Okanogan lobe, Washington: Fryxell, Roald. 00483
Glaciers
Ice
Accumulation, post-Sangamon, N.W.T., Baffin Island: Terasmae, J. 10665
Equilibrium dimensions, sheets, basal water layer effect: Weertman, J. 10406
Movement, Lliboutry theory: Weertman, J. 00362
Movement, sliding of nontemperate: Lliboutry, L. 00427
Movement, sliding of nontemperate: Weertman, J. 00428
Structural features, planar and layered: Ragan, Donal M. 00364
Northwest Territories
Barnes Icecap, Baffin Island, southern, margin fluctuations: Loken, O. H. 10585
Washington
Cascade Range, northern, retreat, photographs: Long, William A. 00486
Yukon
Donjek, Kaskawulsh, chronology: Denton, George H. 10463
Kaskawulsh, fluctuations, Pleistocene: Borns, Harold W., Jr. 10464
Gold
Colorado
Cripple Creek district, geochemical prospecting: Gott, Garland B., Jr. 00454

Gold
United States
Resources, production problems: U.S. Bureau of Mines. 00497
Graptolithina
Climacograptus scalaris kentuckyensis
Silurian, Kentucky, Noland Formation, new subspecies: Berry, William B. N. 00615
Ordovician
North America, Lower, correlation, British faunal zones: Berry, William B. N. 00395
Gravity methods
Interpretation
Anomaly, relation to heat flow anomaly: Simmons, Gene. 00335
Spectral analysis: Hannan, E. J. 10384
Weighting function method: Kanamori, Hiroo. 00426
Gravity surveys
Pacific Ocean
Northeastern, fracture zones: Peter, G. 10503
United States
37th parallel, profiles: Zietz, Isidore. 00464
Utah
Mineral, San Francisco, Beaver, Wah Wah Mts. areas, grabens: Cook, Kenneth L. 10481
Tintic Valley area, interpretation: Mabey, D. R. 00447
Greenland
Glacial geology
Camp Century, ice-sheet budget, radioactivity, reference horizons: Crozaz, G. 10416
Ground water
Florida
Basic data, Escambia, Santa Rosa Counties: Musgrove, Rufus H. 10553
Hawaii
Resources, Kahuku area: Takasaki, K. J. 10339
Resources, Kau District: Davis, Dan A. 10354
Idaho
Resources, King Hill area, potential: Frink, John W. 00496
Kansas
Resources, Neosho County: Jungmann, William L. 10417
Maryland
Data, Baltimore County: Laughlin, Charles P. 10543
Data, Charles County: Slaughter, T. H. 10544
Resources, movement, Patuxent River basin: Crooks, James W. 00453
Massachusetts
Resources, Ipswich River basin: Sammel, E. Z. 10545
Minnesota
Contribution to streamflow, relation to basin characteristics: Ackroyd, E. A. 00458
Mississippi
Resources, Hancock County, Mississippi Test Facility: Newcome, Roy, Jr. 00338
Ground water
Nevada
Resources, quality, Eagle Valley: Worts, G. F., Jr. 10609
New Jersey
Water table, Pine Barren, effect of roots: Laycock, William A. 00344
New Mexico
Levels, Albuquerque area, 1960–2000: Reeder, H. O. 00455
North Carolina
Salt-water intrusion, Frisco area, Hatteras Island: Harris, William H. 00324
Recharge
Water-table mounds, parameter factors: Hantush, Mahdi S. 00329
Temperature
Measurement, dissolved silica in hot spring: Fournier, R. O. 10476
Texas
Movement, Atascosa County, Carrizo Sand, C-14 ages: Pearson, F. J., Jr. 00544
Resources, Brazos River flood-plain alluvium: Cronin, James G. 00518
Resources, Texas Water Plan: Peckham, Richard C. 00472
United States
Atlantic coast, northern, salt-water intrusion: Upson, Joseph E. 10501
Composition, petroleum-bearing formations: Ostroff, A. G. 00563
General, Piedmont and Blue Ridge: LeGrand, H. E. 00354
Resources, by regions: Davis, George H. 00505
Vermont
Resources, Otter Creek basin: Hodges, Arthur L., Jr. 00417
Washington
Levels, Pasco Basin, aquifer relations: Brown, Randall E. 00481
Gulf Coastal Plain
Paleontology
Ostracoda, Cretaceous–Eocene, *Repandocosta* n.gen.: Hazel, Joseph E. 00516
Gulf of Mexico
Geophysical surveys
Continental shelf, off Florida panhandle, seismic, magnetic: Antoine, John. 00361
Stratigraphy
Cretaceous–Recent, off Florida panhandle, core data: Antoine, John. 00361
Structural geology
Continental shelf, off Florida panhandle, diapir, reef: Antoine, John. 00361
Gulf of Saint Lawrence
Structural geology
Silurian strata: Lilly, H. D. 10478
Gymnosperms
Cretaceous
Oregon, Lower, Elk River assemblage: Lowther, J. Stewart. 00487
Cycadeoidea
Mesozoic, North America, microsporangiate structure: Delevoryas, Theodore. 10454

Hawaii
Engineering geology
Tsunamis, Hilo harbor, hydraulic model study: Palmer, Robert Q. 10595
Geochemistry
Kilauea Iki crater, 1959, lavas: Murata, K. J. 10371
Glacial geology
Mauna Kea, Pleistocene glaciation: Wentworth, Chester K. 10447
Hydrogeology
Kahuku area, ground-water resources: Takasaki, K. J. 10339
Kau District, lava flows, perched aquifers: Davis, Dan A. 10354
Marine geology
Oahu, western, submarine reconnaissance: Brock, V. E. 10532
Paleoclimatology
Pleistocene, Mauna Kea: Wentworth, Chester K. 10447
Quaternary, trace-element evidence: Sabels, Bruno E. 10448
Paleontology
Ostracoda, Pliocene?-Recent, drowned terraces: Holden, John C. 00347
Petrology
Kilauea Iki crater, 1959 lavas, differentiation: Murata, K. J. 10371
Oahu, Pearl Harbor area, basalt, Ewa Coastal Plain, cores: Stearns, Harold T. 00460
Sedimentary petrology
Oahu, Pearl Harbor area, Ewa Coastal Plain deposits, cores: Stearns, Harold T. 00460
Soils, mica, pedogenic, ionic relations: Swindale, L. D. 10401
Stratigraphy
Cenozoic, Kau District, volcanic rocks: Davis, Dan A. 10354
Volcanology
Kilauea, ammonium sulfate fume: Cadle, R. D. 00433
Kilauea Iki crater, 1959 eruption, magma body zoning: Murata, K. J. 10371
Heat flow
Conductivity
Anisotropy, layered structure in rocks: Munjal, P. 10390
Limestone, use in petroleum exploration: Lasky, B. H. 00424
Crust
United States, preliminary results: Simmons, Gene. 10555
Geothermal gradient
Measurement, dissolved silica in hot spring: Fournier, R. O. 10476
Interpretation
Anomaly, relation to gravity anomaly: Simmons, Gene. 00335
Measurement
Temperature logging: Simmons, Gene. 10555
Hydrogen
Isotopes
Tritium, production rate, review of investigations: Nir, A. 10413
Hydrogeology
Aquifer properties
Clays, pore-water flow factors: Paaswell, Robert E. 00545
Rocks, soils, physical properties, analyses: Morris, D. A. 00353
Unconfined parameters, hydraulic head, definition: Aron, Gert. 00413
Concepts
Soil-water system, water definition: Arigos, Luis Eduardo. 10344
Experimental studies
Permeability, sand and gravel, desorptive flow: Hayden, John W. 10486
Exploration methods
Well logging, electrical and gamma ray, interpretation: Guyod, Hubert. 10397
Well logging, electrical, interpretation, problems: Alger, R. P. 10546
General
History of science: Nace, Raymond L. 10591
Ground-water contamination
Irrigated areas, chemical controls: Hem, John D. 10487
Petroleum, salt industry operations: Foley, Frank C. 10502
Ground-water movement
Clay sediments, thermal influence: Paaswell, Robert E. 00545
Recharging areas, water-table mounds, parameter factors: Hantush, Mahdi S. 00329
Stream-connected aquifers, flow depletion by pumping well: Hantush, Mahdi S. 00330
Techniques, C-14 ages and flow rates: Pearson, F. J., Jr. 00544
Methods
Aquifer parameters, graphic determination: Aron, Gert. 00413
Factor analysis, hydrologic variants, usefulness questioned: Matalas, N. C. 00328
Permeability determination, sand and gravel, desorptive flow: Hayden, John W. 10486
Resource development
Application of radioisotopes: Csallany, Sandor C. 10498
Basalt aquifers, Idaho, Upper Snake River Plain: Frink, John W. 00496
Fluoride excess, removal: Bower, C. A. 00386
Stream-connected aquifers, well location, effects of pumping: Hantush, Mahdi S. 00330
Well logging, applications: Pfannkuch, Hans-Olaf. 10499
Salt-water intrusion
Barrier islands, relation to sediment permeability: Harris, William H. 00324
Coastal aquifers, United States, northeastern: Upson, Joseph E. 10501
Symposium, salt water-fresh water relationships, coastal research: Parker, Garald G. 10500

Hydrosphere
Origin
Mechanism: Gulbransen, Earl A. 10392
Hydrothermal alteration
Deuteric
Ignimbrite, Nevada: Scott, Robert. 10377
Phase relations
Magnesite–dolomite: Johannes, Wilhelm. 00405
Magnesite–dolomite: Rosenberg, P. E. 00406
Utah
Volcanic sequence, Horn Silver mine area: Stringham, Bronson. 00385
Ice, nonglacial
Northwest Territories
Mackenzie Delta area, pingos, structure: Mackay, J. Ross. 10586
Petrology
Metastable superheated, in fluid inclusions: Roedder, Edwin. 00411
Idaho
Absolute age
Saint Joe region, Beltian rocks, diabase sills: Reid, Rolland R. 00492
Areal geology
Bonner County: Savage, C. N. 00418
Economic geology
Metals, Bonner County, occurrence: Savage, C. N. 00418
Mineral resources, Bonner County, past, potential: Savage, C. N. 00418
Hydrogeology
King Hill area, Snake River plain, basalt aquifer: Frink, John W. 00496
Maps, geologic
Bonner County, bedrock and surficial: Savage, C. N. 00418
Oxbow area, Snake River: Stearns, Harold T. 10600
Paleontology
Mammalia, Pleistocene, Rupert area, bison: Stokes, William Lee. 10490
Petrology
Lochsa, Red River regions, Precambrian rocks: Morrison, Donald A. 00489
Rock Creek Canyon, Columbia River Basalt: Hoffer, Jerry M. 00480
Saint Joe region, Beltian rocks, diabase sills: Reid, Rolland R. 00492
Structural geology
Illinois Peak area, thrust faulting: Nord, Gordon L., Jr. 00490
Lochsa, Red River regions, Beltian(?) rocks, folding: Morrison, Donald A. 00489
Igneous rocks
Basalt
Classification: Chayes, Felix. 10380
Differentiation, Kilauea Iki crater, Hawaii, 1959 eruption: Murata, K. J. 10371
Differentiation, Washington, Rampart Ridge–Keechelus Ridge area: Foster, Robert J. 00491
Pillow structure, Oregon, Cascade Range: Lund, Ernest H. 00488
Igneous rocks
Basalt
Textures, Idaho, Rock Creek Canyon, Columbia River Basalt: Hoffer, Jerry M. 00480
Differentiation
Magnetite–anorthite–quartz system: Roeder, P. L. 10460
Sills, mafic, ultramafic, during flow: Bhattachargi, Somdev. 00561
General
General description, Montana, Dry Mtn. quadrangle: Prostka, Harold J. 10439
Granitic
Alteration, weathering profiles, Georgia, Oklahoma: Harriss, Robert C. 10374
Ignimbrite
Alteration, deuteric, weathering, Nevada: Scott, Robert. 10377
Emplacement, mechanics, mineral variations: Fisher, Richard V. 10368
Petrology, West Indies, Bonaire, Washikemba formation: Beets, D. J. 00365
Pegmatite
Composition, petrology, Saskatchewan, Birch Portage: Radcliffe, Dennis. 10446
Pépérite
Petrology, south-central Washington: Schmincke, Hans-Ulrich. 00434
Physical properties
Thermal anisotropy: Munjal, P. 10390
Ultramafic
Composition, differentiation, Muskox intrusion, Canada: Chamberlain, J. A. 00379
Differentiation, chromian spinels as petrogenetic indicators: Irvine, T. N. 00378
Strontium isotope, alkali element, abundances: Stueber, Alan M. 10366
Volcanic ash
Composition, Alberta, Banff National Park: Westgate, J. A. 00377
Composition, British Columbia, Bridge River ash: Nasmith, H. 00398
Water pressures, magma source, Nevada: Lipman, Peter W. 10469
Volcanics
Alteration, Utah, Horn Silver mine area: Stringham, Bronson. 00385
General description, Oregon–Idaho, Homestead area: Stearns, Harold T. 10600
Petrology, fused tuff, pépérite, Washington: Schmincke, Hans-Ulrich. 00434
Illinois
Economic geology
Ceramic materials, eastern, clay and shale: White, W. Arthur. 00520
Coal, coking properties: Jackman, H. W. 00521
Geochemistry
Champaign County, soil, Ra-226, Rn-222: Pearson, John E. 10356

Illinois
Geomorphology
Loess, thickness, relation to soil development: Jones, Robert L. 10361
Geophysical surveys
Zinc-lead district, magnetic: Heyl, Allen V. 10441
Sedimentary petrology
Soils, clay content, hydrometer and pipette determination: Liu, T. K. 10399
Structural geology
Zinc-lead district, general: Heyl, Allen V. 10441
Weathering
Loess, relation to thickness: Jones, Robert L. 10361
Indiana
Areal geology
South-central, guidebook: Burger, Ann M. 10611
Economic geology
Limestone, Salem Limestone, dimension stone: Rooney, Lawrence F. 10612
Glacial geology
South-central, guidebook: Burger, Ann M. 10611
Paleontology
Echinodermata, Silurian, Osgood Formation, new cystoid: Tillman, C. G. 00568
Sedimentary petrology
Salem Limestone: Rooney, Lawrence F. 10612
Intrusions
Layered
Northwest Territories, Muskox ultramafic: Chamberlain, J. A. 00379
Mechanism
Flow differentiation: Bhattachargi, Somdev. 00561
Sills
Flow differentiation: Bhattachargi, Somdev. 00561
Idaho, Saint Joe region: Reid, Rolland R. 00492
Structure
Utah, Horn Silver mine area: Stringham, Bronson. 00385
Invertebrata
Cambrian-Devonian
New York, elementary account: Weinman, Paul L. 10470
Taxonomy
Treatise, Miscellanea, additions: Rhodes, F. H. T. 10471
Iowa
Geochemistry
Prairie soils, phosphorous, drainage influence: Runge, E. C. A. 10408
Weathering
Loess, role of phosphorous in soil genesis: Runge, E. C. A. 10408
Iron
Geochemistry
Carbonate sediments, Puerto Rico, Vieques Passage: Angino, Ernest E. 00525
Iron
Michigan
Menominee district, Vulcan Iron-Formation, reserves: Bayley, R. W. 10407
Paleomagnetism: Symons, D. T. A. 00430
Wisconsin
Menominee district, Vulcan Iron-Formation, reserves: Bayley, R. W. 10407
Isotopes
Aluminum
Sediments, Pacific Ocean, Al-26: Wasson, John T. 00357
Carbon
Marine dolomite, Oregon, offshore: Russell, K. L. 00359
Marine dolomite, unusual composition: Russell, K. L. 00359
Lead
Zircon, systematic variation in ratios: Steiger, Rudolf H. 10445
Oxygen
Marine dolomite, Oregon, offshore: Russell, K. L. 00359
Radium
Soil, concentration, Illinois: Pearson, John E. 10356
Radon
Emanation, soil, Illinois: Pearson, John E. 10356
Rubidium
Decay constant, Rb-87 half-life determination: McMullen, C. C. 10649
Strontium
Abundance, ultramafic rocks: Stueber, Alan M. 10366
Tracer experiments
Water resources research, applications of radioisotopes: Csallany, Sandor C. 10498
Tritium
Production rate, review of investigations: Nir, A. 10413
Xenon
Meteorites, origin of excess fissiogenic: Fisher, David E. 00463
Jamaica
Areal geology
Geographical background, popular and elementary: Bent, R. M. 10663
Engineering geology
Materials, properties, limestones, soft: Tubey, L. W. 10656
Sedimentary petrology
Limestones, soft, engineering properties: Tubey, L. W. 10656
Soils, bauxitic, mineralogy, genesis, related properties: Ahmad, N. 10400
Kansas
Economic geology
Copper, south-central, red beds, exploration: Hill, Walter E., Jr. 00527
Geochemistry
South-central, geochemical prospecting, Cu, red beds: Hill, Walter E., Jr. 00527

Kansas
Hydrogeology
Neosho County, ground water, aquifers: Jungmann, William L. 10417
Maps, ground water
Neosho County: Jungmann, William L. 10417
Paleontology
Conodonts, Mississippian, northwestern, age span: Goebel, Edwin D. 00528
Pteridophytes, Pennsylvanian, Fleming coal, *Lepidodendron*: Baxter, Robert W. 10554
Stratigraphy
Mississippian, northwestern, core, conodont zones: Goebel, Edwin D. 00528
Neosho County: Jungmann, William L. 10417
Structural geology
Northeastern, joints, Pennsylvanian limestones: Stewart, Gary F. 00529

Kaolin
Alabama
Rock Run, Goshen Valley areas, occurrence, reserves: Cloud, Preston E., Jr. 00448

Kentucky
Economic geology
Clays, Cayce quadrangle: Olive, Wilds W. 00539
Limestone, clays, Lexington West quadrangle: Miller, Robert D. 00471
Limestone, Georgetown quadrangle: Cressman, Earle R. 00562
Mineral resources, Lamasco quadrangle: Sample, Raymond D. 00538
Petroleum, natural gas, bibliography and index maps: Howell, Paul. 10434
Engineering geology
Foundations, Lexington West quadrangle: Miller, Robert D. 00471
General
Bibliography, petroleum, natural gas: Howell, Paul. 10434
Maps, geologic
Cayce quadrangle: Olive, Wilds W. 00539
Georgetown quadrangle: Cressman, Earle R. 00562
Lamasco quadrangle: Sample, Raymond D. 00538
Lexington West quadrangle: Miller, Robert D. 00471
Paleontology
Graptolithina, Silurian, Noland Formation, new subspecies: Berry, William B. N. 00615
Stratigraphy
Mississipppian, Cretaceous, Quaternary, Lamasco quadrangle, section: Sample, Raymond D. 00538
Ordovician, Quaternary, Georgetown quadrangle, section: Cressman, Earle R. 00562
Ordovician, Quaternary, Lexington West quadrangle, section: Miller, Robert D. 00471

Labrador
Glacial geology
Labrador–Ungava area, glaciation causes, meteorologic: Barry, R. G. 10584

Lake Superior region
Paleontology
Microfossils, Precambrian, iron formations: LaBerge, Gene L. 00435

Laterites
Genesis
Hematite adsorption of water, anion effects: Jurinak, J. J. 10364

Lava
Flow mechanism
Idaho, Rock Creek Canyon, Columbia River Basalt, variations: Hoffer, Jerry M. 00480

Lead
Isotopes
Ratios, in zircon: Steiger, Rudolf H. 10445
Mississippi Valley
Upper, structural controls: Heyl, Allen V. 10441

Limestone
Indiana
Salem Limestone, dimension stone, occurrence: Rooney, Lawrence F. 10612
Kentucky
Georgetown quadrangle, resources: Cressman, Earle R. 00562
Lexington West quadrangle, resources: Miller, Robert D. 00471
Tennessee
La Vergne quadrangle, resources: Wilson, Charles W., Jr. 10516
Milton quadrangle, resources: Wilson, Charles W., Jr. 10517
Nashville West quadrangle, resources: Fullerton, Donald S. 10582

Louisiana
Economic geology
Petroleum, Black Lake area, exploration: Lasky, B. H. 00424

Magmas
Composition
Central America, relation to volcanic landform: Weyl, Richard. 10415
Differentiation
Chromian spinels, relation to olivine, pyroxene formation: Irvine, T. N. 00378
Kilauea Iki crater, Hawaii, 1959 eruption: Murata, K. J. 10371
Muskox intrusion, sulfide phases, Northwest Territories: Chamberlain, J. A. 00379
Primary serpentine, water pressures for formation: Kitahara, S. 10373
Water pressures, Nevada, tuff formation: Lipman, Peter W. 10469
Experimental studies
Fractional crystallization, basaltic, ultramafic: Presnall, D. C. 10468
Magnetite–anorthite–quartz system: Roeder, P. L. 10460
Fractional crystallization
Basaltic, ultramafic: Presnall, D. C. 10468

Magnesite
Geochemistry
Replacement of dolomite: Johannes, Wilhelm. 00405

Magnesite
Geochemistry
Replacement of dolomite: Rosenberg, P. E. 00406
Magnesium
Analysis
Atomic absorption spectroscopy, carbonate, silicate rocks: Galle, O. Karmie. 00526
Magnetic methods
Applications
Ore deposits, structural trends: Domzalski, W. 10395
Interpretation
Computer analysis, aeromagnetic data: Wold, Richard J. 10345
Energy density spectrum, autocorrelation function, models: Spector, A. 10396
Spectral analysis: Hannan, E. J. 10384
Magnetic properties
Measurement
Michigan, iron formation, remanence: Symons, D. T. A. 00430
Magnetic surveys
Canada
Shield area, structural trends: Domzalski, W. 10395
Gulf of Mexico
Continental shelf, slope, off Florida panhandle: Antoine, John. 00361
Maine
Island Falls quadrangle, bedrock: Ekren, E. B. 00339
Mississippi Valley
Upper, zinc–lead district: Heyl, Allen V. 10441
Pacific Ocean
Northeastern, fracture zones: Peter, G. 10503
South Carolina
Coastal plain, investigations summary: Straley, H. W., 3d. 10660
United States
37th parallel, profiles: Zietz, Isidore. 00464
Utah
Tintic Valley area, interpretation: Mabey, D. R. 00447
Magnetotelluric methods
Interpretation
Spherical conductors, theory: Srivastava, S. P. 10431
Maine
Geophysical surveys
Island Falls quadrangle, electrical, magnetic, bedrock: Ekren, E. B. 00339
Mineralogy
Muscovite, basal spacings, northwestern, schist: Guidotti, C. V. 10427
Stratigraphy
Cambrian–Devonian, Island Falls quadrangle: Ekren, E. B. 00339
Major-element analyses
Aplites
Saskatchewan, Birch Portage: Radcliffe, Dennis. 10446
Major-element analyses
Beryl
Saskatchewan, Colorado: Radcliffe, Dennis. 10446
Ground water
Florida, Escambia, Santa Rosa Counties: Musgrove, Rufus H. 10553
Kansas, Neosho County: Jungmann, William L. 10417
Maryland, Charles County: Slaughter, T. H. 10544
Massachusetts, Ipswich River basin: Sammel, E. Z. 10545
Mississippi, Hancock County, Mississippi Test Facility: Newcome, Roy, Jr. 00338
Texas, Brazos River flood-plain alluvium: Cronin, James G. 00518
Pegmatites
Saskatchewan, Birch Portage: Radcliffe, Dennis. 10446
Zellerite
Wyoming, Fremont County: Coleman, R. G. 10420
Malacostraca
Caryocaris
Silurian, Oklahoma, Henryhouse Shale, discredited: Branson, Carl C. 00500
Mammalia
Alces
Pleistocene, Alaska, fossil preservation: Guthrie, R. D. 00310
Amynodontopsis bodei
Eocene, South Dakota, Slim Buttes Formation, Harding County: Bjork, Philip R. 00536
Bison
Pleistocene, Alaska, fossil preservation: Guthrie, R. D. 00310
Bison antiquus
Pleistocene, Utah, Kearns and Silver Creek Junction areas: Stokes, William Lee. 10490
Bison latifrons
Pleistocene, Idaho, Rupert area: Stokes, William Lee. 10490
Colodon? cingulatus
Eocene, South Dakota, Slim Buttes Formation, Harding County: Bjork, Philip R. 00536
Epihippus intermedius
Eocene, South Dakota, Slim Buttes Formation, Harding County: Bjork, Philip R. 00536
Equus
Pleistocene, Alaska, fossil preservation: Guthrie, R. D. 00310
Eurylambda
Jurassic, North America, molar pattern, cf. Welsh pantotheres: Crompton, A. W. 00475
Icaronycteris index
Eocene, Wyoming, Green River Formation, bat: Jepsen, Glenn L. 10432
Mammuthus imperator
Pleistocene, Caddo County, Domebo site: Mehl, M. G. 10518

Mammalia
Mammuthus imperator
Pleistocene, Oklahoma, Caddo County, Domebo site: Leonhardy, Frank C. 10505
Mammuthus (Paraelephas) washingtonii
Pleistocene, Washington, Touchet Formation Walla Walla area: Scott, W. Frank. 00493
Ovibos
Pleistocene, Alaska, fossil preservation: Guthrie, R. D. 00310
Panthera atrox
Pleistocene, Alaska, Lost Chicken Creek, jaw: Whitmore, Frank C., Jr. 00311
Rangifer
Pleistocene, Alaska, fossil preservation: Guthrie, R. D. 00310
Teleodus thyboi n. sp.
Eocene, South Dakota, Slim Buttes Formation, Harding County: Bjork, Philip R. 00536
Tertiary
North America, Eocene, fauna, review: Black, Craig C. 10367
Tinodon
Jurassic, North America, molar pattern, cf. Welsh pantotheres: Crompton, A. W. 00475
Manganese
Genesis
Nodules, internal structure: Sorem, Ronald K. 00403
Geochemistry
Silver compounds, occurrence: Hewett, D. F. 00401
Washington
Olympic Peninsula, mineralogy: Sorem, Ronald K. 00394
Manitoba
Maps, aeromagnetic
Barrier Lake area: Canada Geological Survey. 00592
Chemong Creek area: Canada Geological Survey. 00589
Connolly Lake area: Canada Geological Survey. 00583
Culdesac Lake area: Canada Geological Survey. 00591
Lamb Lake area: Canada Geological Survey. 00581
Landry Lake area: Canada Geological Survey. 00585
Moose Lake area: Canada Geological Survey. 00582
Pasquia Lake area: Canada Geological Survey. 00587
Red Earth Lake area: Canada Geological Survey. 00584
Sheet 63 F/6: Canada Geological Survey. 00586
The Pas area: Canada Geological Survey. 00588
Turnberry area: Canada Geological Survey. 00590
Maps, geologic
Issett Lake map-area: Bristol, Calvert C. 10347
Manitoba
Stratigraphy
Precambrian, Issett Lake map-area: Bristol, Calvert C. 10347
Structural geology
Issett Lake map-area, Precambrian rocks: Bristol, Calvert C. 10347
Mantle
Composition
K/Rb, fractionation by amphiboles: Hart, Stanley R. 00376
Ultramafic rocks, geochemistry: Stueber, Alan M. 10366
Elastic waves
Attenuation: Kanamori, Hiroo. 00380
Experimental studies
Magmatic crystallization, chromian spinels, peritectic relations: Irvine, T. N. 00378
General
Exploration, Mohole project: Taylor, Donald M. 10569
Upper Mantle Project, United States program, 1966–70: Knopoff, Leon. 10387
Physical properties
Anelasticity, seismic-wave attenuation, interpretation: Gordon, Robert B. 10343
Electrical properties: Keller, G. V. 10393
United States
Electrical properties: Keller, G. V. 10393
Marine geology
Alaska
Nuka Bay area, submarine glacial features: vonHuene, Roland. 10483
Applications
Pipelines, submarine installation: Miller, David R. 10581
Atlantic Ocean
Continental shelf and slope, U.S., 1962 investigations, summary: Emery, K. O. 10346
Bottom features
Continental rise, evolution: Heezen, Bruce C. 10525
Pacific Ocean, Gulf of Alaska: Gershanovich, D. E. 10526
Pacific Ocean, Gulf of Alaska: Hamilton, E. L. 10521
New England
Continental shelf, southern, sediments, geomorphology: Garrison, Louis E. 10482
Pacific Ocean
Northern, Zetes expedition, scope: Reid, Joseph L. 10386
Quaternary sediments, manganese nodules, correlation with slope: Moore, T. C., Jr. 10378
Palynology
Sediments, paleoecology, possibilities: Groot, Johan J. 10507
Sediments
Bahamas, Tongue of the Ocean, penetration strength tests: Rucker, James B. 00445

Marine geology
Sediments
Equilibrium with ocean water: MacKenzie, Fred T. 10461
Manganese nodules, textures: Sorem, Ronald K. 00403
Paleoecology, palynology, possibilities: Groot, Johan J. 10507
Palynology, Pleistocene and older, relation to base level: Stanley, E. A. 10510
Stability of mineral assemblages: Hess, Paul C. 10355
Structure
Mid-oceanic ridge system, bibliography: Fox, P. J. 10661
Maryland
Geomorphology
Salisbury area, Naylor Mill paleochannel: Hansen, H. J., 3d. 10351
Hydrogeology
Baltimore County, basic ground-water data: Laughlin, Charles P. 10543
Charles County, ground-water data: Slaughter, T. H. 10544
Patuxent River basin, water resources: Crooks, James W. 00453
Maps, ground water
Patuxent River basin: Crooks, James W. 00453
Stratigraphy
Pleistocene, Salisbury area: Hansen, H. J., 3d. 10351
Silurian, Keyser Limestone, correlation with Rondout of New York: Hoar, Florence Grosvenor. 00557
Massachusetts
Engineering geology
Tunnels, Malden Tunnel: Billings, Marland P. 10353
Geomorphology
Cape Cod, beach erosion, cause: Schwartz, Maurice L. 00542
Cape Cod, genesis, popular account: Strahler, Arthur N. 10438
Glacial geology
Cape Cod, genesis, popular account: Strahler, Arthur N. 10438
Taunton quadrangle, deposits: Hartshorn, Joseph H. 00449
Hydrogeology
Ipswich River basin, water resources: Sammel, E. Z. 10545
Maps, geologic
Ipswich River basin: Sammel, E. Z. 10545
Taunton quadrangle, bedrock and surficial: Hartshorn, Joseph H. 00449
Maps, ground water
Ipswich River basin: Sammel, E. Z. 10545
Stratigraphy
Pennsylvanian, Quaternary, Taunton quadrangle: Hartshorn, Joseph H. 00449
Structural geology
Malden Tunnel area: Billings, Marland P. 10353
Mesozoic
New Mexico
Laguna district, stratigraphy: Moench, Robert H. 00420
North America
Reptilia, diosaurs, paleoecology: Russell, L. S. 10508
Gymnosperms, cycadeoids, microsporangiate structure: Delevoryas, Theodore. 10454
Metals
Colorado
Oh-be-joyful quadrangle, resources: Gaskill, David L. 00607
Idaho
Bonner County, mines and prospects, occurrence: Savage, C. N. 00418
Quebec
Baskatong Reservoir area, occurrence: Jacoby, R. S. 10648
Lantagnac-La Touche area occurrence: MacIntosh, J. A. 10628
Metamorphic rocks
General
General description, Alberta, northeastern: Godfrey, John D. 10658
Migmatite
Alteration, Connecticut, southeastern: Lundgren, L. W., Jr. 10484
Mineral assemblages
Discrimination, serpentine group: Faust, George T. 00356
P-T limits, clinozoisite-quartz assemblage: Holdaway, M. J. 10475
Pyroxene-olivine phases, questionable grade indicators: Mueller, Robert F. 10491
Mineral facies
Almandine-amphibolite, Great Basin, relation to structure: Armstrong, Richard Lee. 10369
Delineation, muscovite basal spacings, Maine: Guidotti, C. V. 10427
Epidote composition: Myer, George H. 10375
Idaho, Saint Joe region, Belt Series, diabase sills: Reid, Rolland R. 00492
Vermont, Gile Mountain Formation, semi-pelitic schists: Crawford, Maria Luisa. 10497
Washington, Kettle Range area: Campbell, Charles D. 00482
Physical properties
Thermal anisotropy: Munjal, P. 10390
Schist
Alteration, Connecticut, southeastern: Lundgren, L. W., Jr. 10484
Mineral composition, Vermont, Gile Mtn. Formation: Crawford, Maria Luisa. 10497
Petrology, Alabama, Hillabee Schist, redefined: Carrington, Thomas J. 00442
Serpentinite
Alteration, Ontario, Timmins area: Naldrett, A. J. 10488
Metamorphism
Dynamic
Magnetic effects: Symons, D. T. A. 00430

Metamorphism
P–T conditions
Calc-silicate equilibria: Newton, Robert C. 10372
Pyroxene-olivine stability, questionable grade indicators: Mueller, Robert F. 10491
Regional
Idaho, Lochsa, Red River regions, Beltian(?) rocks: Morrison, Donald A. 00489
Zoning
Connecticut, southeastern, Ordovician schist: Lundgren, L. W., Jr. 10484
Metasomatism
Serpentinite
Talc-carbonate alteration, Ontario, Timmins area: Naldrett, A. J. 10488
Meteorites
Age
Iron, K–Ar, Pb–Sr: Rancitelli, L. 00477
Weekeroo Station, K–Ar: Rancitelli, L. 00477
Canyon Diablo
Ni, Ga, Ge concentrations: Wasson, John T. 00473
Composition
Canyon Diablo, Odessa, Ni, Ga, and Ge concentrations: Wasson, John T. 00473
Chondrites, carbonaceous, organic materials cf. marine sediments: Meinschein, W. G. 10627
Cosmic dust
Deep-sea sediments, cf. Meteor Crater spherules: Ramdohr, Paul. 10619
Earth's atmosphere, space: Cadle, Richard D. 10629
Isotopes, Al-26, Pacific Ocean, sediments: Wasson, John T. 00357
Specific gravity, measurement method: Blanchard, Maxwell B. 00438
Isotopes
Xenon, fissiogenic, origin: Fisher, David E. 00463
Mineralogy
Achondrites, disordered orthopyroxene, occurrence: Pollack, Sidney S. 10425
Nickel-iron spherules
Arizona, Meteor Crater area, genesis: Ramdohr, Paul. 10619
Odessa
Ni, Ga, Ge concentrations: Wasson, John T. 00473
Phase equilibria
Fe, Mg, temperatures, chondrites: VanSchmus, W. R. 00478
Mexico
Areal geology
Northern border, airphotos, Gemini flight: Lowman, Paul D., Jr. 10349
Earthquakes
May 11, 19, 1962, Acapulco, ground motion: Binder, Reuben W. 10436
Engineering geology
Earthquakes, Acapulco, May 1962, ground motion effects: Binder, Reuben W. 10436
Mexico
Engineering geology
Materials, properties, rockfill, laboratory tests: Marsal, Raul J. 00498
Paleontology
Palynomorphs, Cenozoic, Gulf of California sediments: Cross, Aureal T. 10509
Sedimentary petrology
Baja California, Sonoran desert, red beds: Walker, Theodore R. 00437
Gulf of California, bottom surface sediments, ecology: Cross, Aureal T. 10509
Weathering
Baja California, Sonoran desert, red beds: Walker, Theodore R. 00437
Michigan
Areal geology
Dickinson County, Menominee iron-bearing district: Bayley, R. W. 10407
Economic geology
Iron, Menominee district, reserves: Bayley, R. W. 10407
Iron, northern, magnetic properties: Symons, D. T. A. 00430
Maps, geologic
Iron Mountain, Norway, Loretto areas: Bayley, R. W. 10407
Menominee iron-bearing district, Precambrian: Dutton, Carl E. 00351
Maps, magnetic
Menominee iron-bearing district: Bayley, R. W. 10407
Paleomagnetism
Precambrian, iron formation: Symons, D. T. A. 00430
Micropaleontology
Cretaceous
Wyoming-Montana, Foraminifera, Belle Fourche Shale: Eicher, Don L. 00312
Methods
Electron probe analysis, Foraminifera, trace elements: Lipps, Jere H. 00382
Mississippian
New Mexico, Arroyo Penasco Formation: Armstrong, Augustus K. 00370
Precambrian
United States, Canada, iron formations: LaBerge, Gene L. 00435
Preparations
Treatment of insoluble residues: Ireland, H. A. 00618
Quaternary
Bahamas, Great Bahama Bank, surface sediments, distribution: Traverse, Alfred. 10511
Microscope methods
Index liquids
Refractive index determination: Jones, Francis T. 00456
Modal analysis
Point-counter, large specimens: Parker, Ronald B. 10624

Mineragraphy
Reflectivity
Sources of error, surface layer: Eales, Hugh V. 00407
Textures
Manganese minerals: Sorem, Ronald K. 00394
Manganese nodules: Sorem, Ronald K. 00403
Mineral data
Alunite
Genesis, from kaolinitic nodules, Missouri: Keller, W. D. 00608
Amphibole
K/Rb fractionation: Hart, Stanley R. 00376
Andalusite
Crystal chemistry, Fe^{+3}, electron spin resonance spectra: Holuj, F. 10650
Antigorite
Identification, solution method: Faust, George T. 00356
Beryl
Properties, crystal chemistry: Radcliffe, Dennis. 10446
Biotite
Alteration, chemical, biological: Boyle, J. R. 00358
Bornite
Thermal stability, x-bornite phase: Yund, Richard A. 10485
Bredigite
Texas, Culberson County, physical properties: Bridge, Thomas E. 10442
Calcite
Composition, black calcite: Hewett, D. F. 00401
Chrysotile
Identification, solution method: Faust, George T. 00356
Clinochrysotile
Identification, solution method: Faust, George T. 00356
Colemanite
Structure, nonpolar and ferroelectric phases: Hainsworth, F. N. 10644
Copper-iron sulfides
Synthetic, phase relations: Yund, Richard A. 10485
Cordierite
Crystal chemistry, Fe^{+3}, electron spin resonance spectra: Hedgecock, N. E. 10632
Dicalcium silicates
Texas, Culberson County, physical properties: Bridge, Thomas E. 10442
Epidote
Composition, variation: Myer, George H. 10375
Ferropargasite
Synthesis, stability relations: Gilbert, M. Charles. 10465
Hematite
Geochemistry, water adsorption, anion effects: Jurinak, J. J. 10364
Hydroxyapatite
Synthetic, properties, structure: McConnell, Duncan. 10667
Mineral data
Ice
Metastable superheated, in fluid inclusions: Roedder, Edwin. 00411
Larnite
Texas, Culberson County, physical properties: Bridge, Thomas E. 10442
Lizardite
Identification, solution method: Faust, George T. 00356
Mackinawite
Occurrence, distinction from vallerite: Milton, Charles. 10622
Manganese minerals
Occurrence: Sorem, Ronald K. 00394
Manganese oxides
Argentian, black calcite: Hewett, D. F. 00401
Mica
Geochemistry, Hawaiian soils, ionic relations: Swindale, L. D. 10401
Monetite
California, Mono Lake: Cohen, Lewis H. 10424
Montmorillonite
Adsorption, *s*-triazine compounds: Weber, J. B. 10421
Muscovite
Al-Si, long-range order: Fujii, Takashi. 00555
Maine, northwestern, basal spacings: Guidotti, C. V. 10427
Newberyite
California, Mono Lake: Cohen, Lewis H. 10424
Orthopyroxene
Meteorites, disordered, occurrence: Pollack, Sidney S. 10425
Plagioclase
Vermont, Gile Mountain Formation, paragenesis: Crawford, Maria Luisa. 10497
Pyrite
Synthetic: Barnard, Walther M. 00402
Thermal decomposition, kinetics: Coats, A. W. 10626
Pyromorphite
Synthetic, composition, structure: Baker, W. E. 10426
Silicates
Stability, aqueous: Mueller, Robert F. 00543
Tantalite
Synthetic, cell dimensions, composition: Turnock, A. C. 10419
Tapiolite
Synthetic, cell dimensions, composition: Turnock, A. C. 10419
Tin apatite
Synthetic, X-ray diffraction data: McConnell, Duncan. 10667
Vanadium minerals
Occurrence, properties, Canada: Rose, E. R. 00495
Wodginite
Synthetic, cell dimensions, composition: Turnock, A. C. 10419

Mineral data
Zellerite
Wyoming, Fremont County, new uranyl carbonate: Coleman, R. G. 10420
Zeolites
Georgia, Piedmont crystalline rocks: Ramspott, L. D. 00416
Zoisite
Composition variation, optic angle: Myer, George H. 10375
Mineral deposits, genesis
Experimental studies
Copper–iron sulfides, phase relations, stable assemblages: Yund, Richard A. 10485
Geochemical affinities
Barite, western U.S.: Dunham, A. C. 00404
Magnesite: Johannes, Wilhelm. 00405
Magnesite: Rosenberg, P. E. 00406
Lead–silver
Utah, Horn Silver mine: Stringham, Bronson. 00385
Manganese
Washington, Olympic Peninsula: Sorem, Ronald K. 00394
Ore-forming fluids
Experimental studies: Barnard, Walther M. 00402
Silver
United States, southwestern: Hewett, D. F. 00401
Structural controls
Canada, shield area, identification, magnetic anomalies: Domzalski, W. 10395
Zinc–lead, Upper Mississippi Valley: Heyl, Allen V. 10441
Supergene processes
Manganese, Washington: Sorem, Ronald K. 00394
Mineral economics
Gold
Production cost reduction: U.S. Bureau of Mines. 00497
New Hampshire
Conway granite, thorium–uranium recovery: Hurst, F. J. 10418
Mineral exploration
General
Canada, Precambrian Shield, planning and problems: Lehnert-Thiel, Klaus. 00429
Geophysical methods
Drill-hole logging: Zablocki, C. J. 10563
Mineral resources
Canada
General, exploited and potential: Harrison, J. M. 10602
Mineralogy
Composition
Chemical analysis, computer technique, electron-probe data: Rucklidge, J. 00565
Crystal growth
Dolomite: Peterson, M. N. A. 10376
ZrO_2–HfO_2 crystals from PbF_2 melt: Chase, A. B. 10422
Mineralogy
Identification techniques
Solution studies, serpentine-group minerals: Faust, George T. 00356
Pseudomorphism
Newberyite after struvite, California, Mono Lake: Cohen, Lewis H. 10424
Refractive index
Determination on liquids, crystal rotation: Jones, Francis T. 00456
Mining geology
Technology
Gold, need for new methods: U.S. Bureau of Mines. 00497
Minnesota
General
Science Museum, Saint Paul, dinosaur restoration: Erickson, Bruce R. 10573
Hydrogeology
Ground water, contribution to streamflow: Ackroyd, E. A. 00458
Paleontology
Fauna, Ordovician, Maquoketa Formation, repetitive, benthonic: Bayer, Thomas N. 00624
Mississippi
Hydrogeology
Hancock County, Mississippi Test Facility, ground water: Newcome, Roy, Jr. 00338
Mississippian
Alberta
Echinodermata, edrioasteroid, new family: Kesling, Robert V. 00566
Arkansas
Ouachita Mountains, flysch facies: Cline, L. M. 10637
Kansas
Northwestern, conodonts, age span: Goebel, Edwin D. 00528
Missouri
Southwestern, Elsey Formation, relation to Grand Falls chert: Robertson, Charles E. 00457
Montana
Southwestern, Blastoidea, Sappington Formation: Sprinkle, James. 00622
Western, Brachiopoda, Sappington Formation, correlation: Rodriguez, Joaquin. 00606
New Mexico
North-central, Arroyo Penasco Formation: Armstrong, Augustus K. 00370
Oklahoma
Caney, Goddard, Springer Formations, palynology, correlation: Wilson, L. R. 10643
Ouachita Mountains, flysch facies: Cline, L. M. 10637
Ouachita Mountains, Stanley Group: Hill, J. Gilmore. 10652

Mississippian
Oklahoma
Ouachita Mountains, Stanley Group: Johnson, Kent E. 10630
Missouri
Mineralogy
Allophane, alunite, Bates County, shale genesis: Keller, W. D. 00608
Sedimentary petrology
Bates County, Pennsylvanian shale, supergene alteration: Keller, W. D. 00608
Stratigraphy
Mississippian, Elsey Formation, relation to Grand Falls chert: Robertson, Charles E. 00457
Mohorovicic discontinuity
Geochemistry
Phase changes, involving plagioclase: Newton, Robert C. 10372
Mohole project
Review: Taylor, Donald M. 10569
Mollusca
Conoidal shells of uncertain affinities
Taxonomy, treatise, additions: Rhodes, F. H. T. 10471
Quaternary
Ohio, Pleistocene, assemblages, paleoecology: LaRocque, Aurèle. 10457
Oklahoma, Caddo County, Domebo site, Pleistocene, paleoecology: Cheatum, E. P. 10615
Molybdenum
Geochemistry
Soils, Canada, eastern: Gupta, Umesh C. 10423
Montana
Areal geology
Lemhi Pass thorium district: Geach, Robert D. 10610
Economic geology
Thorium, Lemhi Pass district: Geach, Robert D. 10610
Maps, geologic
Toston quadrangle: Robinson, G. D. 00444
Paleontology
Blastoidea, Mississippian, Sappington Formation, southwestern: Sprinkle, James. 00622
Brachiopoda, Devonian–Mississippian, Sappington Formation: Rodriguez, Joaquin. 00606
Foraminifera, Cretaceous, Belle Fourche Shale: Eicher, Don L. 00312
Reptilia, Cretaceous, Hell Creek Formation, northeastern, dinosaur: Erickson, Bruce R. 10573
Petrology
Dry Mountain quadrangle, igneous rocks: Prostka, Harold J. 10439
Stratigraphy
Cretaceous–Quaternary, Dry Mountain quadrangle: Prostka, Harold J. 10439
Montana
Stratigraphy
Precambrian, Belt Supergroup, Lewis and Clark Range, correlation: McGill, George E. 00436
Toston quadrangle: Robinson, G. D. 00444
Structural geology
Dry Mountain quadrangle: Prostka, Harold J. 10439
Neutron diffraction analyses
Data
Colemanite, structure, nonpolar and ferroelectric phases: Hainsworth, F. N. 10644
Nevada
Economic geology
Silver, black calcite: Hewett, D. F. 00401
Geochemistry
East-central, ignimbrite, chemical variations, genesis: Scott, Robert. 10377
Hydrogeology
Eagle Valley, water resources, appraisal: Worts, G. F., Jr. 10609
Maps, geologic
Eagle Valley: Worts, G. F., Jr. 10609
Paleontology
Anthozoa, Permian, Arcturus Group, eastern: Stevens, Calvin H. 00611
Brachiopoda, Ordovician, Ely Springs Dolomite, Pahranagat Range: Howe, Herbert J. 00605
Conodonts, Ordovician, Monocline Valley Formation, Muddy Mts.: Longwell, Chester R. 00439
Ostracoda, Cladocera, Pliocene–Pleistocene, Humboldt Formation: Dickinson, Kendell A. 00621
Porifera, Ordovician, Antelope Valley Formation, Ike's Canyon: Rigby, J. Keith. 00616
Petrology
East-central, ignimbrite, deuteric alteration: Scott, Robert. 10377
Great Basin, almandine-amphibolite facies: Armstrong, Richard Lee. 10369
Southern, Paintbrush, Timber Mountain Tuffs: Lipman, Peter W. 10469
Stratigraphy
Ordovician, Monocline Valley Formation, new, Muddy Mts.: Longwell, Chester R. 00439
Structural geology
Great Basin, Cordilleran infrastructure: Armstrong, Richard Lee. 10369
Weathering
East-central, ignimbrite: Scott, Robert. 10377
New England
Marine geology
Sediments, geomorphology, continental shelf: Garrison, Louis E. 10482
New Hampshire
Economic geology
Thorium, uranium, Conway granite, recovery: Hurst, F. J. 10418

New Jersey
Hydrogeology
Pine Barrens, effect of roots on water table: Laycock, William A. 00344
Sedimentary petrology
Delaware River estuary, sediments, suspended pollen–mineral ratio: Groot, Johan J. 10512
Stratigraphy
Silurian, Decker Formation, correlation with Rondout of New York: Hoar, Florence Grosvenor. 00557

New Mexico
Areal geology
Laguna district: Moench, Robert H. 00420
Economic geology
Silver, Lake Valley district: Hewett, D. F. 00401
Uranium, Laguna district, genesis, occurrence: Moench, Robert H. 00420
Engineering geology
Waterways, Rio Grande Channel, transverse bars, sonic-sounder records: Culbertson, James K. 00414
Geomorphology
Las Cruces area, coppice dunes on Rotura soil: Gile, Leland H. 10357
Hydrogeology
Albuquerque area, water levels 1960–2000: Reeder, H. O. 00455
Maps, geologic
Laguna district: Moench, Robert H. 00420
Torreon quadrangle: Myers, Donald A. 00451
Maps, structure
Laguna district: Moench, Robert H. 00420
Sedimentary petrology
Southern, soils, desert, development: Gile, Leland H. 10489
Stratigraphy
Mississippian, Arroyo Penasco Formation, north-central: Armstrong, Augustus K. 00370
Pennsylvanian, Paradox basin, nomenclature, revised: Baars, D. L. 00369

New York
Paleontology
Annelida, Devonian, Marcellus Formation, Spionidae: Cameron, Barry. 00410
Brachiopoda, Devonian, Onondaga Limestone, pink *Chonetes*: Zenger, Donald H. 00533
Brachiopoda, Silurian, Rondout Formation, Rosendale area: Hoar, Florence Grosvenor. 00557
Invertebrata, Cambrian–Devonian, elementary account: Weinman, Paul L. 10470
Stratigraphy
Devonian, Upper, paleogeography, western: Colton, George W. 00553
Silurian, Rondout Formation, Rosendale area: Hoar, Florence Grosvenor. 00557

Newfoundland
Areal geology
Terra Nova National Park: Baird, David M. 10496
Marine geology
Appalachian folds, extent, east and west: Lilly, H. D. 10478

Nickel
Abundance
Canyon Diablo, Odessa meteorites: Wasson, John T. 00473
North Carolina
Democrat area, prospecting, soils and stream sediments near peridotite: Carpenter, Robert H. 00443

Nodules
Manganese
Concentration, Pacific Ocean, correlation with slope: Moore, T. C., Jr. 10378
Genesis, internal structure: Sorem, Ronald K. 00403

North America
General
Tundra, taiga, developmental history and future: Mackay, J. Ross. 10455
Geochemistry
Precambrian crust, composition: Condie, Kent C. 00620
Paleoclimatology
Tertiary, altitudes of floras, determination: Axelrod, Daniel I. 10456
Paleontology
Brachiopoda, Silurian, *Eocoelia* evolution, cf. Europe: Ziegler, A. M. 10549
Flora, Tertiary, altitude determination method: Axelrod, Daniel I. 10456
Graptolithina, Ordovician, Lower, correlation with British zones: Berry, William B. N. 00395
Gymnosperms, Mesozoic, cycadeoids: Delevoryas, Theodore. 10454
Mammalia, Eocene, late, fauna, review: Black, Craig C. 10367
Mammalia, Jurassic, symmetrodonts, cf. Welsh pantotheres: Crompton, A. W. 00475
Man, prehistory, evidence: Willey, Gordon R. 10662
Reptilia, Triassic–Cretaceous, paleoecology, dinosaurs: Russell, L. S. 10508
Trilobita, Cambrian, Lower, eastern, agnostids: Rasetti, Franco. 00531
Stratigraphy
Ordovician, Lower, correlation with British: Berry, William B. N. 00395
Precambrian, Grenville, restriction of term: Gilluly, James. 10381

North Carolina
Absolute age
Basement rocks, eastern: Denison, Rodger E. 00612
Economic geology
Phosphate, Cape Fear area, occurrence, offshore: Pilkey, Orrin H. 00441

North Carolina
Geochemistry
Democrat area, geochemical prospecting, nickel: Carpenter, Robert H. 00443
Geomorphology
Bodie Island, beach profiles, seasonal variations: Dolan, Robert. 10429
Hydrogeology
Frisco area, Hatteras Island, ground-water stratification: Harris, William H. 00324
Petrology
Eastern, basement rocks: Denison, Rodger E. 00612
North Dakota
Mineralogy
Eastern, Chernozem soils: Redmond, C. E. 00318
Paleontology
Echinoidea, Fox Hills Formation, new cassiduloid: Holland, F. D., Jr. 00534
Sedimentary petrology
Eastern, Chernozem soils, genesis, morphology: Redmond, C. E. 00319
Eastern, Chernozem soils, micromorphology: Redmond, C. E. 00318
Northwest Territories
Absolute age
Isortoq plant-bearing beds, Baffin Island: Terasmae, J. 10665
Geochemistry
Coppermine River area, Muskox intrusion, sulfide facies: Chamberlain, J. A. 00379
Geomorphology
Baffin Island, Inugsuin Fiord, mass movements: Barnett, D. M. 10588
Mackenzie Delta area, pingos, structure: Mackay, J. Ross. 10586
Mackenzie River delta, pingo formation: Bostrom, R. C. 00363
Glacial geology
Baffin Island, Barnes Icecap, south end, fluctuations: Loken, O. H. 10585
Maps, aeromagnetic
Mackenzie, Douglas Lake area: Canada Geological Survey. 00572
Mackenzie, Hanbury Lake area: Canada Geological Survey. 00576
Mackenzie, Ptarmigan Lake area: Canada Geological Survey. 00575
Mackenzie, Radford Lake area: Canada Geological Survey. 00574
Mackenzie, Sheet 76 G/1: Canada Geological Survey. 00577
Mackenzie, Sheet 76 H/4: Canada Geological Survey. 00578
Mackenzie, Sheet 76 H/3: Canada Geological Survey. 00579
Mackenzie, Sheet 76 H/2: Canada Geological Survey. 00580
Mackenzie, Sheet 75 O/2: Canada Geological Survey. 00569
Mackenzie, Smart Lake area: Canada Geological Survey. 00573
Northwest Territories
Maps, aeromagnetic
Mackenzie, Tyrrell Lake West area: Canada Geological Survey. 00571
Mackenzie, Williams Lake area: Canada Geological Survey. 00570
Paleontology
Cephalopoda, Pennsylvanian, Ellesmere Island, *Clistoceras*: Nassichuk, W. W. 00522
Vertebrata, Cretaceous, Anderson River bank, dinosaurs, birds: Russell, Dale A. 00409
Petrology
Coppermine River area, Muskox intrusion, sulfide facies: Chamberlain, J. A. 00379
Stratigraphy
Pleistocene, Isortoq plant-bearing beds, Baffin Island: Terasmae, J. 10665
Nova Scotia
Paleontology
Amphibia, Pennsylvanian, Joggins Formation, labyrinthodonts: Carroll, Robert L. 00532
Ohio
Absolute age
Sunbeam Prairie bog, pollen profile: Kapp, Ronald O. 10466
Paleontology
Crinoidea, Devonian, Silica Formation, new species: Kesling, Robert V. 10657
Fossils, problematic, Ordovician: Ross, June Phillips. 00556
Mollusca, Pleistocene, assemblages, paleoecology: LaRocque, Aurèle. 10457
Oil and gas fields
Oklahoma
Caddo anticline: Becker, Robert M. 10631
Overbrook anticline: Becker, Robert M. 10654
Oklahoma
Absolute age
Caddo County, Domebo site, mammoth bone, wood, C-14: Leonhardy, Frank C. 10505
Caddo County, Domebo site, wood: Albritton, Claude C., Jr. 10527
Areal geology
Ardmore basin, guidebook: Ardmore Geological Society. 10639
Ouachita Mountains, flysch facies and structure, guidebook: Kansas Geological Society. 10638
Economic geology
Petroleum and natural gas, Caddo anticline: Becker, Robert M. 10631
Petroleum and natural gas, Overbrook anticline: Becker, Robert M. 10654
Geochemistry
Granitic rocks, mineral stability sequence, weathering: Harriss, Robert C. 10374
Geomorphology
Caddo County, Tonkawa Creek, Domebo Branch, Quaternary: Retallick, Harold J. 10504

Oklahoma
Paleoclimatology
Pleistocene, Caddo County, Domebo site, late Wisconsin: Leonhardy, Frank C. 10598
Paleontology
Algae, Devonian, Woodford Formation, phylogenetic relations: Wilson, L. R. 00502
Artifacts, with mammoth, Pleistocene, Domebo site: Leonhardy, Frank C. 10505
Asterozoa, Permian, northern, new ophiuroid: Hattin, Donald E. 00381
Fauna, Pennsylvanian, Atoka Formation, Ouachita Mts.: Stark, Philip H. 10633
Malacostraca, Silurian, Henryhouse Shale, phyllocarids, discredited: Branson, Carl C. 00500
Mammalia, Pleistocene, Domebo site, mammoth: Mehl, M. G. 10518
Mollusca, Pleistocene, Domebo site, paleoecology: Cheatum, E. P. 10615
Paleoecology, Pleistocene, Caddo County, Domebo site: Leonhardy, Frank C. 10598
Palynomorphs, Mississippian, Caney, Goddard, Springer Formations: Wilson, L. R. 10643
Palynomorphs, Pennsylvanian, Henryetta and Croweburg coals, correlation: Meyers, W. C. 00504
Palynomorphs, Pleistocene, late succession, Caddo County, Domebo site: Wilson, L. R. 10616
Vertebrata, Pleistocene, Domebo site, fauna, paleoecology: Slaughter, Bob H. 10506
Petrology
Wichita Mountains, granite–rhyolite comagmatic series, names, age: Merritt, C. A. 00501
Sedimentary petrology
Ouachita Mountains, Stanley Group: Johnson, Kent E. 10630
Ouachita Mountains, Stanley Group, sandstones, provenance: Hill, J. Gilmore. 10652
Stratigraphy
Mississippian, Stanley Group, Ouachita Mts.: Hill, J. Gilmore. 10652
Mississippian, Stanley Group, Ouachita Mts.: Johnson, Kent E. 10630
Paleozoic, late, Ouachita Mountains, flysch facies: Cline, L. M. 10637
Pennsylvanian, Ardmore area, northern: Parker, Everett C. 10655
Pennsylvanian, Atoka Formation, Ouachita Mts.: Stark, Philip H. 10633
Pennsylvanian, Henryetta and Croweburg coals, correlation: Meyers, W. C. 00504
Pennsylvanian, Lake Murray area: Lang, Robert C. 10642
Pleistocene, Beaver and Harper Counties, lake deposits, sections: Schemel, Mart P. 00503
Pleistocene, Domebo Formation, Caddo County, type section: Albritton, Claude C., Jr. 10527

Oklahoma
Stratigraphy
Pliocene, Laverne Formation, Beaver and Harper Counties, sections: Schemel, Mart P. 00503
Quaternary, Caddo County, Domebo site, stream terraces: Albritton, Claude C., Jr. 10527
Structural geology
Ardmore area, Overbrook anticline: Becker, Robert M. 10654
Southern, framework: Dott, Robert H. 10641
Weathering
Granite: Harriss, Robert C. 10374
Ontario
Absolute age
Granitic rocks, Rb/Sr, Sudbury area: Hart, S. R. 00614
Economic geology
Uranium, thorium, southern, occurrence, production: Hewitt, D. F. 00419
Geomorphology
Meaford area, Niagara Escarpment, Pleistocene mass movement, frost induced: Straw, Allan. 10587
Paleontology
Bryozoa, Ordovician, Middle, ectoproct evolution: Ross, June Phillips. 00623
Petrology
Timmins area, serpentinized peridotites, alteration: Naldrett, A. J. 10488
Optical mineralogy
Optic angle
Zoisite: Myer, George H. 10375
Ordovician
Alaska
East-central, stratigraphy: Brabb, Earl E. 00343
General
Trilobita, Agnostida, ontogeny, instars of *Trinodus*: Hunt, Allen S. 00530
Michigan
Gastropoda, borings, carnivorous, Trentonian limestones: Cameron, Barry. 00322
Minnesota
Paleoecology, Maquoketa Formation: Bayer, Thomas N. 00624
Nevada
Ike's Canyon, Porifera, Antelope Valley Formation: Rigby, J. Keith. 00616
Muddy Mountains, Monocline Valley Formation, new: Longwell, Chester R. 00439
Pahranagat Range, Brachiopoda, Ely Springs Dolomite, correlations: Howe, Herbert J. 00605
New York
Gastropoda, borings, carnivorous, Trentonian limestones: Cameron, Barry. 00322
North America
Correlation, Lower, with British: Berry, William B. N. 00395
Ohio
Fossils, problematic, Upper: Ross, June Phillips. 00556

Ordovician
Ontario
Bryozoa, ectoproct evolution: Ross, June Phillips. 00623
Texas
Central, Wilberns Formation, Trilobita: Winston, Don. 00559
United States
Northern, central, Bryozoa, evolution: Ross, June Phillips. 00623
Virginia
Edinburg Limestone, Trilobita, agnostid ontogeny, quantitative: Hunt, Allen S. 00530
Oregon
Areal geology
Homestead area, Oxbow dam site, Snake River: Stearns, Harold T. 10600
Engineering geology
Shorelines, Clatsop Beach, accretion and erosion, history: Kidby, Harold A. 10577
Geochemistry
Columbia River estuary, sediments, Zn-65, retention: Johnson, Vernon. 00325
Isotopes, oxygen, carbon, marine dolomite, offshore: Russell, K. L. 00359
Geophysical surveys
Coast Ranges, seismic, crustal profile: Berg, Joseph W., Jr. 10360
Maps, geologic
Oxbow area, Snake River: Stearns, Harold T. 10600
Marine geology
Dolomite, isotopic composition, unusual: Russell, K. L. 00359
Paleontology
Gymnosperms, Cretaceous, Lower, Elk River assemblage: Lowther, J. Stewart. 00487
Petrology
Eastern, Picture Gorge ignimbrite: Fisher, Richard V. 10368
McKenzie River–Scott Creek area, basalt, pillow structure: Lund, Ernest H. 00488
Radioactivity
Columbia River estuary, sediments, Zn-65: Johnson, Vernon. 00325
Volcanology
Eastern, pyroclastic flows, emplacement mechanism: Fisher, Richard V. 10368
Organic materials
Analytical methods
Fluorine, in fossils: Egan, Gail N. 10352
Bitumens
Classification, table: Kayser, Robert B. 10358
Hydrocarbons
Gases, origin, graphite–hydrogen reactions: Gulbransen, Earl A. 10392
Meteorites and sediments, comparison: Meinschein, W. G. 10627
Orogeny
Absolute age
Interpretation: Gilluly, James. 10381
Arbuckle
Oklahoma, southern: Dott, Robert H. 10641
Orogeny
Causes
Cosmic events: Fairbridge, R. W. 10494
General
Relation to plutons: Platt, Lucian B. 10467
Mechanism
Nappe hypothesis, Arkansas, Ouachita Mts.: Viele, George W. 10636
Periodicity
Correlation with cosmic cycles: Fairbridge, R. W. 10494
Wichita
Oklahoma, southern: Dott, Robert H. 10641
Ostracoda
Cenozoic
Hawaii, Pliocene?–Recent, drowned terraces, shallow-water fauna: Holden, John C. 00347
Cletocythereis noblissimus
Pleistocene, Alaska, assigned to *Acanthocythereis*: Schmidt, Ruth A. M. 00609
Cythereis pauca
Paleocene, Atlantic Coastal Plain, type species for *Repandocosta*: Hazel, Joseph E. 00516
Hemicytheridae
Recent, Atlantic Ocean, northeastern, distribution, classification: Hazel, Joseph E. 00548
Krithe
Tertiary, Caribbean region, distribution, morphology, stratigraphic value: Bold, W. A. van den. 10359
Orionina
Tertiary, Caribbean region, distribution, morphology, stratigraphic value: Bold, W. A. van den. 10359
Pseudocythereis simpsonensis
Pleistocene, Alaska, assigned to *Echinocythereis*: Schmidt, Ruth A. M. 00609
Quaternary
Alaska, Gubik Formation, generic assignments: Schmidt, Ruth A. M. 00609
Mexico, Baja California, ecology: McKenzie, K. G. 00390
Nevada, Humboldt Formation, freshwater fauna: Dickinson, Kendell A. 00621
Nicaragua, Pacific Coast, ecology: Swain, Frederick M. 00391
Repandocosta, n.gen.
Cretaceous–Eocene, Gulf and Atlantic Coastal Plains: Hazel, Joseph E. 00516
Trachyleberididae
Recent, Atlantic Ocean, northeastern, distribution, classification: Hazel, Joseph E. 00548
Pacific Islands
Paleoclimatology
Quaternary, trace-element evidence, tropical: Sabels, Bruno E. 10448

Pacific Ocean
Geochemistry
Al-26 in sediments, implications: Wasson, John T. 00357
Geomorphology
Gulf of Alaska, bottom features: Gershanovich, D. E. 10526
Geophysical surveys
Aleutian basin, Bering Sea, north-central, acoustic: Buffington, Edwin C. 10530
Gulf of Alaska, acoustic reflection, reconnaissance: Hamilton, E. L. 10521
Northeastern, fracture zones, magnetic, gravity: Peter, G. 10503
Marine geology
Northern, Zetes expedition: Reid, Joseph L. 10386
Mineralogy
Clay minerals, sediments: Gorbunova, Z. N. 10533
Sedimentary petrology
Central, sediments, nodules, correlation with slope: Moore, T. C., Jr. 10378
Gulf of Alaska, sediments: Gershanovich, D. E. 10526
Horizon Guyot, manganese nodules: Sorem, Ronald K. 00403
Structural geology
Aleutian arc, tectonics: Perry, Richard B. 10531
Aleutian basin, Bering Sea, north-central: Buffington, Edwin C. 10530
Gulf of Alaska, continental to oceanic transition: vonHuene, Roland. 10529
Northeastern, fracture zones: Peter, G. 10503
Paleobotany
Environmental analysis
Tertiary floras, North America, altitude determination: Axelrod, Daniel I. 10456
Potassium-argon dates
Eocene floras: Axelrod, Daniel I. 10459
Resins
X-ray study, modern and fossil: Frondel, Judith W. 00412
Paleoclimatology
Cycles
Correlation with cosmic cycles: Fairbridge, R. W. 10494
Indicators
Labyrinthodonts, Carboniferous, Permian: Irving, E. 10479
Labyrinthodonts, Carboniferous, Permian: Stehli, Francis G. 10480
Marine sediments, palynology: Groot, Johan J. 10507
Quaternary
Canada, Labrador-Ungava area, Pleistocene, air circulation patterns: Barry, R. G. 10584
Hawaii, Mauna Kea, Pleistocene glaciation: Wentworth, Chester K. 10447
Oklahoma, Caddo County, Domebo site, late Wisconsin: Leonhardy, Frank C. 10598
Paleoclimatology
Quaternary
Pacific Islands, tropical, trace-element evidence: Sabels, Bruno E. 10448
Yukon, Saint Elias Mts.: Borns, Harold W., Jr. 10464
Temperature
Tertiary, North America, altitudes of floras, method: Axelrod, Daniel I. 10456
Tertiary
North America, floras, altitude determination: Axelrod, Daniel I. 10456
Wyoming, iron content of fossil bones: Houston, R. S. 10623
Paleoecology
Blastoidea
Mississippian, marine, Montana: Sprinkle, James. 00622
Branchiopoda
Pliocene-Pleistocene, lacustrine: Dickinson, Kendell A. 00621
Changes
North America, Triassic to Cretaceous, dinosaurs: Russell, L. S. 10508
Indicators
Marine sediments, palynology: Groot, Johan J. 10507
Paleosalinity, boron in clay, method evaluation: Lerman, A. 10414
Mollusca
Pleistocene, nonmarine assemblages, cf. Recent: LaRocque, Aurèle. 10457
Pleistocene, terrestrial, Oklahoma, Domebo site: Cheatum, E. P. 10615
Ordovician
Benthonic, Maquoketa Formation, Minnesota: Bayer, Thomas N. 00624
Ostracoda
Pliocene-Pleistocene, lacustrine: Dickinson, Kendell A. 00621
Palynomorphs
Pennsylvanian, coastal, Pennsylvania, Lower Kittanning coal, facies: Habib, D. 10550
Pleistocene, terrestrial, Oklahoma, Domebo site, assemblages: Wilson, L. R. 10616
Tertiary, terrestrial, British Columbia, Queen Charlotte Islands: Martin, Helene A. 10647
Pennsylvanian
Marine, Oklahoma, Ouachita Mts., Atoka Formation: Stark, Philip H. 10633
Quaternary
Terrestrial, Oklahoma, Caddo County, Domebo site: Leonhardy, Frank C. 10598
Reptilia
North America, Triassic to Cretaceous, dinosaurs: Russell, L. S. 10508
Vertebrata
Pleistocene, terrestrial, Oklahoma, Domebo site: Slaughter, Bob H. 10506
Paleogeography
Alaska
Cambrian-Ordovician, east-central: Brabb, Earl E. 00343

Paleogeography
Cretaceous
Alberta–British Columbia, Rocky Mtn. Foothills, Smoky Group: Stott, D. F. 00494
Wyoming–Montana, Belle Fourche depositional period: Eicher, Don L. 00312
Cycles
Correlation with cosmic cycles: Fairbridge, R. W. 10494
Devonian
New York, western: Colton, George W. 00553
Mapping, methods
Paleocurrent analysis: Klein, George deVries. 00368
Pennsylvanian
Texas, Glass Mountains: Ross, Charles A 00397
Tertiary
Utah, Green River Formation: Picard, M. Dane. 00546
Paleomagnetism
Precambrian
Michigan, iron formation: Symons, D. T. A. 00430
Reversals
Field intensity during process: Harrison, C. G. A. 10379
Paleontology
Fossil preservation
Mammalia, Pleistocene, Alaska: Guthrie, R. D. 00310
Fossilization
Devonian soft-bodied worm: Cameron, Barry. 00410
Methods
Cluster analysis, Fager coefficient and weighted pair group: Valentine, J. W. 00610
Statistical, estimation of percents: Chang, Yi-Maw. 00384
Treatment of insoluble residues: Ireland, H. A. 00618
Practice
Soviet Union vs. North America, facilities and research: Saint Jean, Joseph. 00617
Taxonomy
Cephalopoda, Coleoidea: Jeletzky, J. A. 10472
Invertebrate treatise, Miscellanea, additions: Rhodes, F. H. T. 10471
Paleozoic
Arkansas
Ouachita Mountains, eastern core: Sterling, Philip J. 10646
General
Gastropoda, Pleurotomariacea, taxonomy, nomenclature: Batten, Roger L. 00524
Palynology
Cenozoic
Mexico, Gulf of California sediments, source and distribution: Cross, Aureal T. 10509
Environmental analysis
Estuary, sedimentation, Delaware River, pollen–mineral ratio: Groot, Johan J. 10512
Marine sediments, abyssal plains, ocean rises: Groot, Johan J. 10507
Palynology
Environmental analysis
Mexico, Gulf of California, bottom sediments, palynomorphs: Cross, Aureal T. 10509
Interpretation
Marine sediments, reworked, base-level change, clue: Stanley, E. A. 10510
Mississippian
Oklahoma, Caney, Goddard, Springer Formations, correlation: Wilson, L. R. 10643
Pennsylvanian
Oklahoma, Henryetta and Croweburg coals, correlation: Meyers, W. C. 00504
Pennsylvania, western, Lower Kittanning coal, distribution: Habib, D. 10550
Quaternary
Bahamas, Great Bahama Bank, surface sediments, distribution: Traverse, Alfred. 10511
Oklahoma, Caddo County, Domebo site, late Pleistocene: Wilson, L. R. 10616
Tertiary
British Columbia, Skonun Formation, Queen Charlotte Islands: Martin, Helene A. 10647
Textbooks
General: Nair, P. K. K. 10606
Palynomorphs
Pennsylvanian
Pennsylvania, western, Lower Kittanning coal, descriptions: Habib, D. 10550
Paragenesis
Manganese ores
Washington, Olympic Peninsula: Sorem, Ronald K. 00394
Semi-pelitic schists
Vermont, Gile Mountain Formation, plagioclase relations: Crawford, Maria Luisa. 10497
Pegmatite
Saskatchewan
Birch Portage, beryl-bearing: Radcliffe, Dennis. 10446
Pelecypoda
Inoceramus
Cretaceous, Alaska, Matanuska Formation, southern: Jones, David L. 00341
Shell sizes
Frequency distribution, Bahamas, statistical analysis: Craig, Gordon Y. 00554
Pennsylvania
Paleontology
Palynomorphs, Pennsylvanian, Lower Kittanning coal, western: Habib, D. 10550
Stratigraphy
Silurian, Keyser Limestone, correlation with Rondout of New York: Hoar, Florence Grosvenor. 00557
Pennsylvanian
Arkansas
Ouachita Mountains, flysch facies: Cline, L. M. 10637
Kansas
Southeastern, pteridophytes, Fleming coal: Baxter, Robert W. 10554

Pennsylvanian
Northwest Territories
Ellesmere Island, Cephalopoda, *Clistoceras*, morphology: Nassichuk, W. W. 00522
Nova Scotia
Joggins area, Joggins Formation, Amphibia: Carroll, Robert L. 00532
Oklahoma
Ardmore area, northern, stratigraphy: Parker, Everett C. 10655
Ardmore basin, stratigraphy, guidebook: Ardmore Geological Society. 10639
Murray Lake area, stratigraphy: Lang, Robert C. 10642
Northeastern, Henryetta and Croweburg coals, correlation: Meyers, W. C. 00504
Ouachita Mountains, Atoka Formation: Stark, Philip H. 10633
Ouachita Mountains, flysch facies: Cline, L. M. 10637
Pennsylvania
Western, palynomorphs, Lower Kittanning coal: Habib, D. 10550
Texas
Glass Mountains, Gaptank Formation, revision: Ross, Charles A. 00397
Western, Haymond Formation: Dean, Walter E., Jr. 00541
United States
Southwestern, Paradox basin, nomenclature, revised: Baars, D. L. 00369
Permafrost
North America
Tundra and taiga: Mackay, J. Ross. 10455
Northwest Territories
Mackenzie Delta area, pingos, structure: Mackay, J. Ross. 10586
Permeability
Experimental studies
Water movement, sand and gravel, desorptive curve: Hayden, John W. 10486
Sandstones
Determination, nuclear magnetism log: Seevers, D. O. 10556
Permian
Nevada
Eastern, Anthozoa, Arcturus Group, Leonardian rugose: Stevens, Calvin H. 00611
Oklahoma
Northern, Asterozoa, new ophiuroid: Hattin, Donald E. 00381
Texas
Baylor County, Reptilia: Baird, Donald. 00314
Bryozoa, Guadalupian, Girtyporidae, n.fam. for *Domopora?*: Morozova, I. P. 10592
Craddock Ranch, Arroyo Formation, Amphibia: Cys, John M. 00535
Utah
Pisces: Vaughn, Peter Paul. 00323
Petrofabrics
Folds
Sedimentary rocks, geometry, analysis technique: Viele, George W. 10635
Petrofabrics
Mesoscopic fractures
Rocky Mountains, Canada, tectonic interpretation: Price, R. A. 00393
Petroleum
Accumulation
Regional factors: Al-Khersan, Hashim F. 00549
Alberta
Athabasca oil sands, evaluation, data processing: Fetzner, R. W. 10570
Lloydminster, Wainwright, Chauvin areas, Sparky sand, evaluation: Brown, James S. 10547
Exploration
Formation water characteristics, use: Ostroff, A. G. 00563
Heat flow anomaly, porosity trap: Lasky, B. H. 00424
Log analysis, fractured reservoirs: Pirson, S. J. 00423
Radioactivity logging: Pirson, S. J. 10564
Reservoir analysis, static data, interpretation, averaging: Havlena, D. 10551
Sandstone permeability, nuclear magnetism log: Seevers, D. O. 10556
Sandstone units, interpretation: Potter, Paul Edwin. 00367
Well logs, systematic analysis, parameters: Pirson, S. J. 10402
Well-log analysis, hydrodynamic entrapments: Pirson, S. J. 00422
Kentucky
Bibliography, index maps: Howell, Paul. 10434
Oklahoma
Caddo anticline, occurrence, production: Becker, Robert M. 10631
Overbrook anticline: Becker, Robert M. 10654
Saskatchewan
Lloydminster area, Sparky sand, evaluation: Brown, James S. 10547
Well data
Storage, computer system, case history: Stauft, D. L. 10552
Petrology
Instruments
Point-counter, modal analysis: Parker, Ronald B. 10624
Phase equilibria
Calc-silicate
P-T curves, thermodynamic constants: Newton, Robert C. 10372
Chondrites
Fe, Mg, temperatures: VanSchmus, W. R. 00478
Chromian spinels
Crystallization, silicate magmas: Irvine, T. N. 00378
Clinozoisite-quartz
Relative stability with epidote-anorthite-grossularite: Holdaway, M. J. 10475

Phase equilibria
Cu–Fe–S
Thermal stability, experimental: Yund, Richard A. 10485
Epidote–anorthite–grossularite
Relative stability with clinozoisite–quartz: Holdaway, M. J. 10475
FeO–MnO–Ta_2O_5–O
Experimental studies: Turnock, A. C. 10419
Ferropargasite
Synthetic: Gilbert, M. Charles. 10465
Forsterite–diopside–iron oxide
Experimental studies: Presnall, D. C. 10468
Hydrous K–Na–Al silicates
Equilibrium relations, 25°C, 1 atm.: Hess, Paul C. 10355
Magnesite–dolomite
Solubility: Johannes, Wilhelm. 00405
Solubility: Rosenberg, P. E. 00406
Magnetite–anorthite–quartz
Liquidus relations, experimental studies: Roeder, P. L. 10460
MgO–SiO_2–H_2O
Variations with increasing pressure: Kitahara, S. 10373
Multisystems of n+3 phases
Theoretical treatment: Zen, E-an. 10458
Orthopyroxene–forsterite
Solubility of SiO_2: Mueller, Robert F. 00543
Pyroxene–olivine
Metamorphic conditions, questionable grade indicators: Mueller, Robert F. 10491
Unary systems
Stability, sequences and levels: Kujawa, Frank B. 10473
ZrO_2–HfO_2
Mixed crystals, growth in PbF_2 melt: Chase, A. B. 10422
Phosphate
North Carolina
Cape Fear area, continental shelf deposit: Pilkey, Orrin H. 00441
Photogeology
Interpretation
Gemini photos, Mexico–United States border area: Lowman, Paul D., Jr. 10349
Washington
Cascade Range, glacier retreat: Long, William A. 00486
Pisces
Actinopterygii
Permian, Utah, vertebrae, ossified: Vaughn, Peter Paul. 00323
Deltodus
Paleozoic, dentition: Berman, David S. 00321
Devonian
New York, Upper, western, fecal pellets(?): Colton, George W. 00553
Janassa
Paleozoic, dentition: Berman, David S. 00321
Lepisosteus sp.
Eocene, South Dakota, Slim Buttes Formation, Harding County: Bjork, Philip R. 00536
Pisces
Morphology
Janassa, Deltodus: Berman, David S. 00321
Vertebrae ossification, Utah, Permian: Vaughn, Peter Paul. 00323
Popular and elementary geology
Fossils
Invertebrate, New York: Weinman, Paul L. 10470
Jamaica
Geographical background: Bent, R. M. 10663
Massachusetts
Cape Cod, genesis: Strahler, Arthur N. 10438
Newfoundland
Terra Nova National Park: Baird, David M. 10496
Porifera
Pennsylvanian
Oklahoma, Atoka Formation, Ouachita Mts., flysch assemblages: Stark, Philip H. 10633
Toquimiella curvata n.gen. n.sp.
Ordovician, Nevada, Antelope Valley Formation, Ike's Canyon: Rigby, J. Keith. 00616
Potash
Exploration
General: Goldsmith, Louis H. 10557
Genesis
General: Goldsmith, Louis H. 10557
Potassium
Abundance
Ultramafic rocks: Stueber, Alan M. 10366
Geochemistry
Amphibole, K/Rb ratio: Hart, Stanley R. 00376
Precambrian
Alberta
Bayonet, Ashton, Potts and Charles Lakes districts: Godfrey, John D. 10658
Canada
Cobalt Series, fossil bacteria: Jackson, Togwell A. 00476
Idaho
Bonner County, Belt Series: Savage, C. N. 00418
Manitoba
Issett Lake map-area, stratigraphy and structure: Bristol, Calvert C. 10347
Michigan
Menominee iron-bearing district, Carney Lake Gneiss: Bayley, R. W. 10407
Montana
Lewis and Clark Range, Belt Supergroup, correlation: McGill, George E. 00436
North America
Crust, composition: Condie, Kent C. 00620
Nomenclature, Grenville, term restriction: Gilluly, James. 10381
Quebec
Baskatong Reservoir area, Grenville Precambrian province: Jacoby, R. S. 10648
Lantagnac–La Touche area, Opemisca and related units: MacIntosh, J. A. 10628

Pteridophytes
Lepidodendron serratum
Pennsylvanian, Kansas, Fleming coal, growth habit: Baxter, Robert W. 10554
Puerto Rico
Economic geology
Mineral resources, Corozal quadrangle: Nelson, Arthur E. 00352
Geochemistry
Vieques Passage, carbonate sediments, iron: Angino, Ernest E. 00525
Maps, geologic
Corozal quadrangle: Nelson, Arthur E. 00352
Stratigraphy
Cretaceous–Quaternary, Corozal quadrangle, section: Nelson, Arthur E. 00352
Structural geology
Corozal quadrangle: Nelson, Arthur E. 00352
Pyrite
Geochemistry
Thermal decomposition, kinetics: Coats, A. W. 10626
Quaternary
Alaska
Correlation, interglacial marine: Flint, Richard Foster. 10474
Lost Chicken Creek, Mammalia, Pleistocene cat: Whitmore, Frank C., Jr. 00311
Mammalia, fossil preservation: Guthrie, R. D. 00310
Ostracoda, Gubik Formation: Schmidt, Ruth A. M. 00609
Alberta
Banff National Park, Recent, volcanic ash, correlation: Westgate, J. A. 00377
Atlantic Ocean
Continental shelf, North America, northeastern, Ostracoda: Hazel, Joseph E. 00548
British Columbia
South-central, Bridge River and other Recent ash beds: Nasmith, H. 00398
Hawaii
Kau District, volcanic rocks, stratigraphy: Davis, Dan A. 10354
Idaho
Rupert area, Mammalia, bison: Stokes, William Lee. 10490
Maryland
Salisbury area, Pleistocene stratigraphy: Hansen, H. J., 3d. 10351
Mexico
Baja California, Ostracoda, ecology: McKenzie, K. G. 00390
Nevada
Elko, Lander Counties, Ostracoda, Cladocera: Dickinson, Kendell A. 00621
Nicaragua
Ostracode assemblages compared: Swain, Frederick M. 00391
North America
Man, cultures, evidence: Willey, Gordon R. 10662
Quaternary
Northwest Territories
Baffin Island, Isortoq plant-bearing beds: Terasmae, J. 10665
Ohio
Mollusca, Pleistocene, assemblages, paleoecology: LaRocque, Aurèle. 10457
Oklahoma
Beaver, Harper Counties, Pleistocene diatomaceous deposits: Schemel, Mart P. 00503
Caddo County, Domebo site, mammoth with artifacts: Leonhardy, Frank C. 10505
Caddo County, Domebo site, palynology, late Pleistocene: Wilson, L. R. 10616
Caddo County, Domebo site, stratigraphy: Albritton, Claude C., Jr. 10527
Pacific Ocean
Central, sediments, thickness correlated with slope: Moore, T. C., Jr. 10378
North America, coast, Ostracoda, ecology: Swain, Frederick M. 00391
Utah
Kearns and Silver Creek Junction areas, Mammalia, bison: Stokes, William Lee. 10490
Virginia
Correlation, interglacial marine: Flint, Richard Foster. 10474
Quebec
Areal geology
Baskatong Reservoir area: Jacoby, R. S. 10648
Lantagnac–La Touche area: MacIntosh, J. A. 10628
Glacial geology
Labrador–Ungava area, glaciation causes, meteorologic: Barry, R. G. 10584
Maps, geologic
Baskatong Reservoir area, eastern: Jacoby, R. S. 10648
Lantagnac–La Touche area: MacIntosh, J. A. 10628
Sherbrooke–Orford–Memphremagog area, surficial: McDonald, Barrie C. 00537
Radar methods
Interpretation
Local geology: Rydstrom, Hubert O. 00396
Radioactivity
Sediments
Washington, Oregon, Columbia River estuary, Zn-65 retention: Johnson, Vernon. 00325
Soils
Illinois, Champaign County, Ra-226, Rn-222: Pearson, John E. 10356
Radioactivity methods
Applications
Petroleum exploration, well-log anomalies: Pirson, S. J. 10564
Uranium exploration, quantitative logging: Dodd, Philip H. 10558

Radioactivity methods
Applications
Water-well logging, gamma ray, interpretation: Guyod, Hubert. 10397
Interpretation
Ice-sheet budget, nuclear-test debris, Greenland: Crozaz, G. 10416
Techniques
Radionuclide movement, Columbia River estuary: Prych, Edmund A. 10579
Radiolaria
Pennsylvanian
Oklahoma, Atoka Formation, Ouachita Mts., flysch assemblages: Stark, Philip H. 10633
Radium
Isotopes
Ra-226, concentration, soil, Illinois: Pearson, John E. 10356
Radon
Isotopes
Rn-222, emanation, soil, Illinois: Pearson, John E. 10356
Reefs
Bahamas
Quaternary, Great Bahama Bank, palynology, sedimentation: Traverse, Alfred. 10511
Texas
Pennsylvanian, Gaptank Formation: Ross, Charles A. 00397
Reptilia
Allognathosuchus sp., cf. A. riggsi
Eocene, South Dakota, Slim Buttes Formation, Harding County: Bjork, Philip R. 00536
Captorhinus
Permian, Texas, senior synonym of *Hypopnous*: Baird, Donald. 00314
Cimoliasaurus?
Cretaceous, Northwest Territories, Anderson River bank: Russell, Dale A. 00409
Graptemys? sp.
Eocene, South Dakota, Slim Buttes Formation, Harding County: Bjork, Philip R. 00536
Hypopnous
Permian, Texas, synonomy with *Captorhinus aguti*: Baird, Donald. 00314
Mesozoic
North America, Triassic-Cretaceous, paleoecology, dinosaurs: Russell, L. S. 10508
Nomenclature
Captorhinus, Hypopnous: Baird, Donald, 00314
Pachyrhinosaurus
Cretaceous, Alberta, Edmonton Formation, Drumheller area: Langston, Wann, Jr. 00399
Platecarpus ictericus
Cretaceous, Northwest Territories, Anderson River bank: Russell, Dale A. 00409
Plesiosauria
Cretaceous, Northwest Territories, Anderson River bank: Russell, Dale A. 00409
Reptilia
Triceratops prorsus
Cretaceous, Montana, Hell Creek Formation, restoration: Erickson, Bruce R. 10573
Rivers
Channel geometry
Bed forms, thalweg profiles, equipment: Carey, Walter C. 00415
New Mexico, Rio Grande, transverse bars, sonic-sounder records: Culbertson, James K. 00414
Drainage patterns
Network topology, graph theory: Scheidegger, A. E. 00326
Geochemistry
Dissolved constituents, balance with oceans: MacKenzie, Fred T. 10461
Oklahoma
Caddo County, Tonkawa Creek, Domebo Branch, Quaternary history: Retallick, Harold J. 10504
Sediment transport
Bed forms, thalweg profiles, equipment: Carey, Walter C. 00415
Measurement of variables, experimental techniques: Rathbun, R. E. 00327
New Mexico, Rio Grande, transverse bars, sonic-sounder records: Culbertson, James K. 00414
Rocky Mountains
Structural geology
Alberta-British Columbia, mesoscopic subfabrics, tectonics: Price, R. A. 00393
Rubidium
Abundance
Ultramafic rocks: Stueber, Alan M. 10366
Geochemistry
Amphibole, K/Rb ratio: Hart, Stanley R. 00376
Isotopes
Rb-87, half-life determination: McMullen, C. C. 10649
Salt tectonics
Texas
Anderson County, Keechi dome: Ebanks, Gerald Keith. 00550
Saskatchewan
Economic geology
Petroleum, Lloydminster area, Sparky sand, evaluation: Brown, James S. 10547
Geomorphology
Southern, map of glacial and preglacial valleys: Christiansen, E. A. 00346
Geophysical surveys
Lloydminster area, resistivity and porosity logging: Brown, James S. 10547
Maps, aeromagnetic
Barrier Lake (Manitoba) area: Canada Geological Survey. 00592
Chemong Creek (Manitoba) area: Canada Geological Survey. 00589
Culdesac Lake (Manitoba) area: Canada Geological Survey. 00591
Turnberry (Manitoba) area: Canada Geological Survey. 00590

Saskatchewan
Maps, geomorphologic
Southern, glacial and preglacial valleys: Christiansen, E. A. 00346
Mineralogy
Beryl, Birch Portage: Radcliffe, Dennis. 10446
Sea water
Composition
Bicarbonate and alkali metals, removal: MacKenzie, Fred T. 10461
Evolution, solution equilibrium model: Kramer, James R. 10520
Time variations, CO_2–carbonate relations: Holland, Heinrich D. 10537
Geochemistry
Carbonate solids, solution behavior: Weyl, P K. 10535
Interactions with suspended minerals: Chave, Keith E. 10519
Mass balance with river water: MacKenzie, Fred T. 10461
Nepheloid layers, significance: ElWardani, S. A. 10542
Silica, control by silica minerals: Mackenzie, Fred T. 00392
Silicate dissolution, Alaska, southeastern coast: Sharma, G. D. 10539
Sedimentary rocks
Carbonate rocks
Classification, diagenesis of marine: Sander, N. J. 00366
Classification
Carbonate rocks of marine origin: Sander, N. J. 00366
Dolomite
Geochemistry, isotopic composition, Oregon, offshore: Russell, K. L. 00359
Evaporites
Genesis, thermodynamics, open system, model: Schmalz, Robert F. 10538
Hydrologic properties
Analyses, 1948–60, U.S. Geol. Survey, Hydrologic Lab.: Morris, D. A. 00353
Limestone
Petrology, Jamaica, engineering properties: Tubey, L. W. 10656
Lithofacies
Alaska, east-central, Cambrian–Ordovician: Brabb, Earl E. 00343
Physical properties
Analyses, 1948–60, U.S. Geol. Survey, Hydrologic Lab.: Morris, D. A. 00353
Thermal anisotropy: Munjal, P. 10390
Red beds
Alteration, Baja California, cf. Colorado, hematite origin: Walker, Theodore R. 00437
Sandstone
Petrology, provenance, Oklahoma, Ouachita Mts., Stanley Group: Hill, J. Gilmore. 10652
Physical properties, induced polarization, salinity, shalyness effects: Schoeppel, R. J. 10562
Sedimentary rocks
Sandstone
Provenance, environments of deposition: Potter, Paul Edwin. 00367
Shale
Alteration, supergene, Missouri: Keller, W. D. 00608
Sedimentary structures
Crossbedding
Utah, Green River Formation: Picard, M. Dane. 00546
Current markings
New York, Devonian, Upper: Colton, George W. 00553
Oklahoma, Stanley Group: Johnson, Kent E. 10630
General
Current direction, environment, identification: Klein, George deVries. 00368
Ripple marks
Utah, Green River Formation: Picard, M. Dane. 00546
Sedimentation
Alluvial channels
Bed forms, sonic-sounder observation: Culbertson, James K. 00414
Bed forms, thalweg profiles, equipment: Carey, Walter C. 00415
Cyclic
Texas, Pennsylvanian, Gaptank Formation: Ross, Charles A. 00397
Environment
Beach, California, central coast: Johnson, J. W. 10575
Beach, littoral processes: Inman, Douglas L. 10574
Estuary, Delaware River, sediments, suspended, pollen–mineral ratio: Groot, Johan J. 10512
Estuary, Washington, Puget Sound, Fox Island spit: Jenson, Lawrence E. 00485
Identification, sand bodies: Potter, Paul Edwin. 00367
Lagoon, Hawaii, Oahu, Pearl Harbor area: Stearns, Harold T. 00460
Ocean, sediment, dispersal pattern, coastal: Klein, George deVries. 00368
River, travertine deposition, California: Slack, Keith V. 00342
Experimental studies
Evaporites, thermodynamics, open system, model: Schmalz, Robert F. 10538
Stream transport variables, measurement techniques: Rathbun, R. E. 00327
Ocean currents
Beaches, seasonal variations, North Carolina, Bodie Island: Dolan, Robert. 10429
Carbonate banks, microfossil clue, Great Bahama Bank region: Traverse, Alfred. 10511
Coastal processes, engineering problems: Johnson, J. W. 10451

Sedimentation
Ocean-current
Sediment dispersal, paleo- cf. modern, coastal environment: Klein, George deVries. 00368
Stream transport
Alluvial channels, straight: Maddock, Thomas, Jr. 10590
Measurement of variables, experimental techniques: Rathbun, R. E. 00327
Turbidity currents
Flysch facies, Paleozoic, Ouachita Mountains: Cline, L. M. 10637
Mississippian geosyncline, Oklahoma, Ouachita Mts.: Johnson, Kent E. 10630
Texas, Haymond Formation: Dean, Walter E., Jr. 00541
Sediments
Carbonate
Equilibrium textures, sediment-seawater system, model: Schmalz, Robert F. 10534
Geochemistry, iron distribution, Puerto Rico, Vieques Passage: Angino, Ernest E. 00525
Clays
Geochemistry, boron content, paleosalinity estimation: Lerman, A. 10414
Ecology
Mexico, Gulf of California, palynomorphs: Cross, Aureal T. 10509
Environment
Continental shelf, New England, southern: Garrison, Louis E. 10482
Identification, sand bodies: Potter, Paul Edwin. 00367
General
General description, California, Santa Catalina basin: Gaal, Robert A. P. 10523
General description, Pacific Ocean, Gulf of Alaska: Gershanovich, D. E. 10526
Geochemistry, clay minerals, exchangeable cations, Alaska: Knowles, L. I. 10541
Geochemistry, Columbia River estuary, Zn-65 retention: Johnson, Vernon. 00325
Mineral composition, clay, Alaska, Taku estuary: Kunze, G. W. 10540
Mineral composition, size analysis, Atlantic coastal waters: Bond, Gerard C. 10621
Pacific Ocean, thickness, correlation with slope: Moore, T. C., Jr. 10378
Geochemistry
Organic materials, cf. meteorites: Meinschein, W. G. 10627
Pacific Ocean, Al-26 content, implications: Wasson, John T. 00357
Gravel
Fabric analysis, Washington, Puget Sound, Fox Island spit: Jenson, Lawrence E. 00485
Methods
Infrared photography, dune sands: Stanley, Daniel J. 00371
Specific gravity, microsize particles: Blanchard, Maxwell B. 00438
Physical properties
Penetration strength, in-situ, marine, Bahamas: Rucker, James B. 00445
Sediments
Provenance
Pleistocene and older marine, palynology indicators: Stanley, E. A. 10510
Sand
Distribution, in depositional environments: Potter, Paul Edwin. 00367
Mineral composition, California, central coast: Johnson, J. W. 10575
Seismic methods
Interpretation
Spectral analysis: Hannan, E. J. 10384
Techniques
Arrays, acoustic transmission in oceans: Clay, C. S. 10412
Linear array processing, comparison of methods: Green, P. E., Jr. 10385
Seismic surveys
Alaska
Nuka Bay area, glacial-marine geology: vonHuene, Roland. 10483
Gulf of Mexico
Continental shelf, slope, off Florida panhandle: Antoine, John. 00361
Oregon
Crustal studies, Coast Ranges: Berg, Joseph W., Jr. 10360
Pacific Ocean
Aleutian basin, Bering Sea, acoustic: Buffington, Edwin C. 10530
Gulf of Alaska, acoustic reflection, reconnaissance: Hamilton, E. L. 10521
Washington
Crustal studies, Coast Ranges: Berg, Joseph W., Jr. 10360
World
Crustal studies, summary: Lee, W. H. K. 10382
Seismology
Education
International Institute, history: Kisslinger, Carl. 00507
Elastic waves
Attenuation, source in mantle: Gordon, Robert B. 10343
P, PcP, spectra, mantle-core boundary, attenuation in mantle: Kanamori, Hiroo. 00380
Shore features
Beaches
Sedimentation, seasonal variations, North Carolina, Bodie Island: Dolan, Robert. 10429
Shorelines
Ancient
Utah, Uinta Basin, Eocene: Picard, M. Dane. 00546
California
Central coast, sediment movement, nearshore: Johnson, J. W. 10575
Changes
Cause, sea-level rise, Bruun's rule: Schwartz, Maurice L. 00542
Littoral processes: Inman, Douglas L. 10574

Shorelines
Florida
Inlets, beach erosion, bypassing and backpassing: Bruun, P. M. 10576
Oregon
Clatsop Beach, changes, history: Kidby, Harold A. 10577
Silicon
Geochemistry
Sea water, dissolution, Alaska: Sharma, G. D. 10539
Sea water, silica control: Mackenzie, Fred T. 00392
Soils, silica, solubility: Miller, Raymond W. 00317
Silurian
Indiana
Echinodermata, Osgood Formation, new cystoid: Tillman, C. G. 00568
Kentucky
Graptolithina, Noland Formation: Berry, William B. N. 00615
New York
Southeastern, Rondout Formation, Brachiopoda: Hoar, Florence Grosvenor. 00557
North America
Brachiopoda, *Eocoelia*, evolution, cf. Europe: Ziegler, A. M. 10549
Oklahoma
Henryhouse Shale, Malacostraca, phyllocarids, discredited: Branson, Carl C. 00500
Silver
Geochemistry
Manganates, southwestern U.S.: Hewett, D. F. 00401
Properties
Reflectivity: Eales, Hugh V. 00407
Sodium
Abundance
Ultramafic rocks: Stueber, Alan M. 10366
Soils
Alberta
Cypress Hills plateau, paleosol: Jungerius, P. D. 10589
Canada
Eastern, podzol, Cu and Mo status, relation to properties: Gupta, Umesh C. 10423
Composition
Clay content, hydrometer and pipette determination, comparison: Liu, T. K. 10399
Engineering properties
Creep rates, stress effect, experimental studies: Andersland, O. B. 00540
In-situ testing, techniques, vane-shear and cone-penetration: Am. Society for Testing and Materials. 10340
Laboratory tests, computer programs: Knodel, Paul C. 10613
Moisture, post-infiltration, redistribution, hysteresis effects: Rubin, J. 00315
Moisture-strength relations, trafficability: Bassett, J. R. 00320
Soils
Engineering properties
Penetration resistance, testing, portable penetrometer: Sowers, George F. 10341
Shear strength, California, San Francisco Bay mud: Boitano, J. D. 10342
Shear strength, California, San Francisco Bay mud: Miller, E. A. 10410
Swelling, solution composition effect, experimental study: McNeal, B. L. 10443
Genesis
Illinois, relation to loess thickness: Jones, Robert L. 10361
Iowa, loess-derived, role of phosphorous: Runge, E. C. A. 10408
New Mexico, Las Cruces area, Rotura soil, coppice dunes: Gile, Leland H. 10357
Geochemistry
Fluorine adsorption: Bower, C. A. 00386
Iowa, phosphorous, drainage influence: Runge, E. C. A. 10408
Limestone particles, coatings, experimental study: Barrows, H. L. 10435
Phosphates, fractionation method, Wisconsin soils: Petersen, G. W. 10363
Silica, solubility: Miller, Raymond W. 00317
Geomorphology
New Mexico, Las Cruces area, Rotura soil, coppice dunes: Gile, Leland H. 10357
Hawaii
Mica, pedogenic, ionic relations: Swindale, L. D. 10401
Hydrogeologic properties
Pore-water flow factors, temperature dependence: Paaswell, Robert E. 00545
Analyses, 1948-60, U.S. Geol. Survey, Hydrologic Lab.: Morris, D. A. 00353
Jamaica
Bauxitic, mineralogy, genesis, related properties: Ahmad, N. 10400
New Mexico
Southern, desert, development: Gile, Leland H. 10489
North Dakota
Eastern, Chernozem soils, genesis, morphology, profiles: Redmond, C. E. 00319
Eastern, Chernozem soils, mineralogy: Redmond, C. E. 00318
Physical properties
Analyses, 1948-60, U.S. Geol. Survey, Hydrologic Lab.: Morris, D. A. 00353
South Carolina
Geophysical surveys
Coastal plain, magnetic, summary: Straley, H. W., 3d. 10660
Structural geology
Coastal plain, major lineaments, epicenter and magnetic data: Straley, H. W., 3d. 10660

South Dakota
Paleontology
Vertebrata, Eocene, Slim Buttes Formation, Harding County: Bjork, Philip R. 00536
Specific gravity
Cosmic dust
Measurement method: Blanchard, Maxwell B. 00438
Measurement
Microsize particles: Blanchard, Maxwell B. 00438
Spectroscopy
Absorption
Atomic, Ca, Mg determination, carbonate and silicate rocks: Galle, O. Karmie. 00526
Instruments, spectrometer, high resolution atomic: Salotti, Charles A. 00479
Infrared
Clay surface acidity, determination: Harter, Robert D. 00316
Mössbauer effect
Surface studies, Fe^{57} on Ag: Godwin, Robert Paul. 00613
Springs
Submarine
Relation to coastal hydrology: Kohout, F. A. 10572
Statistical measures
Spatial extrapolation
Spherical data: Kaula, W. M. 00337
Statistical methods
Geomorphology
Sampling: Carson, M. A. 00560
Hydrogeology
Factor analysis, usefulness questioned: Matalas, N. C. 00328
Paleontology
Cluster analysis: Valentine, J. W. 00610
Frequency distributions, shell sizes: Craig, Gordon Y. 00554
Geometrical growth increments, Trilobita, agnostid instars: Hunt, Allen S. 00530
Variance analysis: Chang, Yi-Maw. 00384
Sedimentary petrology
Variance analysis, Pennsylvanian sedimentation: Dean, Walter E., Jr. 00541
Stratigraphy
Education
Field trip substitute: Tomikel, John. 00513
Nomenclature
Pennsylvanian System, United States, southwestern: Baars, D. L. 00369
Principles
Manganese nodules, internal structure: Sorem, Ronald K. 00403
Stromatolites
Cambrian
Floras, stratigraphic, geographic distribution: Johnson, J. Harlan. 10453
Strontium
Abundance
Ultramafic rocks: Stueber, Alan M. 10366
Strontium
Isotopes
Abundance, ultramafic rocks: Stueber, Alan M. 10366
Structural geology
Education
Smith College, sand models: Schalk, Marshall. 00512
Stereonet, classroom demonstration tool: Dunn, David E. 00511
Methods
Deformation geometry, sedimentary rocks, fabric analysis technique: Viele, George W. 10635
Deformation intensity indicators, mean-dip maps: Greenwood, W. R. 00484
Surveys
Geological Survey of Canada
Exploration, Canadian Shield, northern, 1952–65: Wright, G. M. 10664
United States Geological Survey
Research 1966: U.S. Geological Survey. 10433
Tectonics
Alpine structure
Mechanics, Ouachita Mountains, Ark.: Viele, George W. 10636
Island arcs
Review: Linehan, Daniel. 10348
Processes
Spreading sea floor hypothesis: Dietz, Robert S. 10370
Rocky Mountains
Mechanics, Alberta–British Columbia: Price, R. A. 00393
Tennessee
Economic geology
Construction materials, chert, Graves Spring quadrangle: Larson, Lawrence T. 10571
Limestone, gravel, barite, La Vergne quadrangle: Wilson, Charles W., Jr. 10516
Limestone, zinc, Milton quadrangle: Wilson, Charles W., Jr. 10517
Mineral resources, Bonnertown quadrangle: Miller, Robert A. 10583
Mineral resources, Nashville West quadrangle: Fullerton, Donald S. 10582
Maps, geologic
Bonnertown quadrangle: Barnes, Robert H. 10605
Graves Spring quadrangle: Barnes, Robert H. 10604
Graves Spring quadrangle: Larson, Lawrence T. 10571
La Vergne quadrangle: Wilson, Charles W., Jr. 10516
Milton quadrangle: Wilson, Charles W., Jr. 10517
Nashville West quadrangle: Wilson, Charles W., Jr. 10515
Maps, index
Geologic, status to 1967: Tennessee Division of Geology. 00421

Tertiary
Atlantic Coastal Plain
Ostracoda, Paleocene–Eocene, *Repandocosta* n.gen.: Hazel, Joseph E. 00516
British Columbia
Queen Charlotte Islands, Skonun Formation, palynology: Martin, Helene A. 10647
Caribbean region
Biostratigraphy, Ostracoda: Bold, W. A. van den. 10359
Gulf Coastal Plain
Ostracoda, Paleocene–Eocene, *Repandocosta* n.gen.: Hazel, Joseph E. 00516
Hawaii
Kau District, Ninole Volcanic Series: Davis, Dan A. 10354
North America
Mammalia, fauna, late Eocene: Black, Craig C. 10367
Oklahoma
Beaver, Harper Counties, Laverne Formation: Schemel, Mart P. 00503
South Dakota
Harding County, Slim Buttes Formation, Vertebrata: Bjork, Philip R. 00536
Trinidad
Biostratigraphy, Foraminifera, correlation: Bolli, Hans M. 10495
Utah
Asphalt Ridge area, stratigraphy: Kayser, Robert B. 10358
Raven Ridge, Red Wash areas, Green River Formation: Picard, M. Dane. 00546
Washington
Rampart Ridge, Naches Formation, not Keechelus: Foster, Robert J. 00491
South-central, Selah Member, Ellensburg Formation: Schmincke, Hans-Ulrich. 00434
Texas
Absolute age
Atascosa County, ground water in Carrizo Sand, C–14: Pearson, F. J., Jr. 00544
Economic geology
Coal, north-central, southern, resources: Mapel, W. J. 00334
Hydrogeology
Atascosa County, Carrizo Sand, ground-water, C–14 ages and flow: Pearson, F. J., Jr. 00544
Brazos River, flood-plain alluvium: Cronin, James G. 00518
Ground-water resources, Texas Water Plan: Peckham, Richard C. 00472
Mineralogy
Bredigite, larnite, γ dicalcium silicates, Culberson County: Bridge, Thomas E. 10442
Paleontology
Amphibia, Permian, Arroyo Formation, Craddock Ranch: Cys, John M. 00535
Arthropoda, Cretaceous, Paluxy Formation, Albian conchostracans: Tasch, Paul. 00313
Bryozoa, Permian, Girtyporidae, n.fam. for *Domopora?*: Morozova, I. P. 10592
Texas
Paleontology
Echinoidea, Cretaceous, Glen Rose Limestone, descriptions, new species: Whitney, Marion I. 10428
Reptilia, Permian, Baylor County, Captorhinomorpha: Baird, Donald. 00314
Trilobita, Cambrian–Ordovician, Wilberns Formation: Winston, Don. 00559
Sedimentary petrology
Marathon region, Haymond Formation, turbidite strata: Dean, Walter E., Jr. 00541
Stratigraphy
Cambrian–Ordovician boundary, Wilberns Formation: Winston, Don. 00559
Pennsylvanian, Gaptank Formation, Glass Mts., revision: Ross, Charles A. 00397
Pennsylvanian, Haymond Formation, turbidite strata, correlation: Dean, Walter E., Jr. 00541
Structural geology
Anderson County, Keechi salt dome: Ebanks, Gerald Keith. 00550
Live Oak, McMullen Counties, Gueydan Formation, clastic diapirism: Freeman, Paul S. 00551
Thallium
Abundance
Silver ores, southwestern U.S.: Hewett, D. F. 00401
Thermal springs
Submarine
Relation to coastal hydrology: Kohout, F. A. 10572
Thermodynamic properties
Activation energy
$FeCO_3$ to α–Fe_2O_3: Seguin, Maurice. 10477
Carbonate sediments
Sea water, solution behavior: Weyl, P. K. 10535
Enthalpy of fusion
Binary systems, experimental: Adams, Leason H. 10462
Free energy
Unary systems, theoretical models: Kujawa, Frank B. 10473
Fugacity
Oxygen, magma: Presnall, D. C. 10468
Thorium
Isotopes
Ratios, in zircon: Steiger, Rudolf H. 10445
Montana
Lemhi Pass district, occurrence: Geach, Robert D. 10610
New Hampshire
Conway granite, recovery: Hurst, F. J. 10418
Ontario
Southern, mines and prospects, occurrence, production: Hewitt, D. F. 00419
Trace elements
Abundance
Soils, Pacific Islands, Quaternary climates, evidence: Sabels, Bruno E. 10448

Trace elements
Analysis
Atomic absorption spectrometer, description: Salotti, Charles A. 00479
Trace-element analyses
Amphibole
K/ Rb fractionation: Hart, Stanley R. 00376
Carbonate sediments
Puerto Rico, Vieques Passage, iron distribution: Angino, Ernest E. 00525
Foraminifera
Carbonate tests, electron probe: Lipps, Jere H. 00382
Tracks and trails
Pisces
Devonian, Upper, New York, fecal pellets(?): Colton, George W. 00553
Trace fossils and borings
Taxonomy, treatise, additions: Rhodes, F. H. T. 10471
Trilobita
Agnostida
Cambrian, Lower, North America, eastern, taxonomy, biofacies: Rasetti, Franco. 00531
Ontogeny, instars of *Trinodus*, quantitative definition: Hunt, Allen S. 00530
Bathyuriscus fimbriatus
Cambrian, Middle, Utah, western, ontogeny, cf. ptychopariids: Robison, Richard A. 00506
Cambrian
Texas, Wilberns Formation, zones, new species: Winston, Don. 00559
Corynexochida
Cambrian, ontogeny of *Bathyuriscus*, relation to Ptychopariida: Robison, Richard A. 00506
Ordovician
Texas, Wilberns Formation, zones, new species: Winston, Don. 00559
Trinodus elspethi
Ordovician, Middle, Virginia, ontogeny, quantitative: Hunt, Allen S. 00530
Trinidad
Paleontology
Foraminifera, Cretaceous–Tertiary, planktonic, zonation: Bolli, Hans M. 10495
Stratigraphy
Cretaceous–Tertiary, planktonic foraminifera zonation: Bolli, Hans M. 10495
Tsunamis
Hawaii
Hilo harbor, hydraulic model study: Palmer, Robert Q. 10595
United States
Absolute age
Western, flora, Eocene age: Axelrod, Daniel I. 10459
Areal geology
Mexican border area, airphotos, Gemini flight: Lowman, Paul D., Jr. 10349
Economic geology
Barite, western: Dunham, A. C. 00404
Gold, resources, production: U.S. Bureau of Mines. 00497
United States
Engineering geology
Soils, penetration resistance, testing, penetrometer: Sowers, George F. 10341
Geochemistry
Southwestern, irrigation areas, salt-balance concept: Hem, John D. 10487
Geophysical surveys
Crust, mantle, electrical: Keller, G. V. 10393
Denver basin, electrical logging, correlation with geology: Keller, George V. 10567
37th parallel, magnetic, gravity, profiles: Zietz, Isidore. 00464
Hydrogeology
Atlantic coast, northern, salt-water intrusion: Upson, Joseph E. 10501
Ground-water resources, by regions: Davis, George H. 00505
Piedmont and Blue Ridge, ground water, yield: LeGrand, H. E. 00354
Southwestern, irrigation areas, salt-balance concept: Hem, John D. 10487
Maps, geologic
General: Kinney, Douglas M. 10617
Paleontology
Bryozoa, Ordovician, Middle, ectoproct evolution: Ross, June Phillips. 00623
Sedimentary petrology
Soils, clay content, hydrometer and pipette determination: Liu, T. K. 10399
Structural geology
Pacific Northwest, Olympic–Wallowa lineament, crustal boundary: Skehan, James W. 10403
Uranium
Exploration
Radioactivity logging, program, interpretation: Dodd, Philip H. 10558
Isotopes
Ratios, in zircon: Steiger, Rudolf H. 10445
New Hampshire
Conway granite, recovery: Hurst, F. J. 10418
New Mexico
Laguna district, occurrence, genesis, resources: Moench, Robert H. 00420
Ontario
Southern, mines and prospects, occurrence, production: Hewitt, D. F. 00419
Utah
Economic geology
Bitumens, Asphalt Ridge, occurrence: Kayser, Robert B. 10358
Coal, resources, southwestern: Grose, L. T. 00619
Lead-silver, Horn Silver mine, occurrence: Stringham, Bronson. 00385
Silver, Ophir, San Francisco: Hewett, D. F. 00401
Geophysical surveys
Mineral, San Francisco, Beaver, Wah Wah Mts. areas, gravity, grabens: Cook, Kenneth L. 10481

Utah
Geophysical surveys
Tintic Valley area, gravity, magnetic, interpretation: Mabey, D. R. 00447
Maps, geologic
Asphalt Ridge area: Kayser, Robert B. 10358
Horn Silver mine and vicinity: Stringham, Bronson. 00385
Tintic Valley area, with magnetic, gravity data: Mabey, D. R. 00447
Paleontology
Mammalia, Pleistocene, Kearns and Silver Creek Junction areas, bison: Stokes, William Lee. 10490
Pisces, Permian, vertebrae, ossified: Vaughn, Peter Paul. 00323
Trilobita, Cambrian, Middle, western, *Bathyuriscus*, ontogeny: Robison, Richard A. 00506
Petrology
Great Basin, almandine-amphibolite facies: Armstrong, Richard Lee. 10369
Horn Silver fault area, volcanic sequence, intrusions: Stringham, Bronson. 00385
Stratigraphy
Cretaceous-Tertiary, Asphalt Ridge area: Kayser, Robert B. 10358
Eocene, Green River Formation, Uinta Basin, paleogeography: Picard, M. Dane. 00546
Pennsylvanian, Paradox basin, nomenclature, revised: Baars, D. L. 00369
Structural geology
Great Basin, Cordilleran infrastructure: Armstrong, Richard Lee. 10369
Horn Silver fault area: Stringham, Bronson. 00385
Valleys
Saskatchewan
Southern, map of glacial and preglacial: Christiansen, E. A. 00346
Vanadium
Canada
Occurrence, potential, chemical field test: Rose, E. R. 00495
Vermont
Hydrogeology
Otter Creek basin, ground-water favorability: Hodges, Arthur L., Jr. 00417
Maps, ground water
Otter Creek basin, favorability: Hodges, Arthur L., Jr. 00417
Mineralogy
Plagioclase, Gile Mountain Formation, paragenesis: Crawford, Maria Luisa. 10497
Petrology
Eastern, Gile Mountain Formation, plagioclase paragenesis: Crawford, Maria Luisa. 10497
Vertebrata
Quaternary
Oklahoma, Caddo County, Domebo site, Pleistocene, fauna, paleoecology: Slaughter, Bob H. 10506
Virginia
Paleontology
Trilobita, Ordovician, Middle, agnostid ontogeny, quantitative: Hunt, Allen S. 00530
Stratigraphy
Pleistocene, interglacial marine, correlation: Flint, Richard Foster. 10474
Volcanism
Explosive
Air-sea wave generation, Krakatoa: Press, Frank. 10430
Mechanism
Pyroclastic flows, emplacement: Fisher, Richard V. 10368
Volcanoes
Alaska
Mounts Trident and Martin, July-Aug. 1965, activity: Ward, Peter. 10607
Central America
Types, relation to magma character: Weyl, Richard. 10415
Hawaii
Kilauea, ammonium sulfate fume: Cadle, R. D. 00433
Washington
Areal geology
Rampart Ridge-Keechelus Ridge area: Foster, Robert J. 00491
Economic geology
Manganese, Olympic Peninsula: Sorem, Ronald K. 00394
Geochemistry
Columbia River estuary, sediments, Zn-65, retention: Johnson, Vernon. 00325
Geophysical surveys
Coast Ranges, seismic, crustal profile: Berg, Joseph W., Jr. 10360
Glacial geology
Cascade Range, northern, glacier retreat, photographs: Long, William A. 00486
North-central, Cordilleran Ice Sheet, Okanogan lobe, flow pattern: Fryxell, Roald. 00483
Hydrogeology
Pasco Basin, ground-water levels, aquifer relations: Brown, Randall E. 00481
Paleontology
Mammalia, Pleistocene, Touchet Formation, Walla Walla area, mammoth: Scott, W. Frank. 00493
Petrology
Kettle Range area, metamorphism, bedded facies, granites: Campbell, Charles D. 00482
South-central, Selah Member, Ellensburg Formation, fused vitric tuff: Schmincke, Hans-Ulrich. 00434
Radioactivity
Columbia River estuary, sediments, Zn-65: Johnson, Vernon. 00325
Sedimentary petrology
Puget Sound, Fox Island spit: Jenson, Lawrence E. 00485

Washington
Stratigraphy
Tertiary, Naches Formation, not Keechelus Andesite, Rampart Ridge: Foster, Robert J. 00491
Structural geology
Kettle Range area, metamorphic rocks, foliation: Campbell, Charles D. 00482
Weathering
Colorado
Red beds, hematite origin: Walker, Theodore R. 00437
Granite
Oklahoma, Georgia: Harriss, Robert C. 10374
Ignimbrite
Nevada: Scott, Robert. 10377
Illinois
Loess, thickness, relation to soil development: Jones, Robert L. 10361
Loess
Illinois, relation to thickness: Jones, Robert L. 10361
Mexico
Red beds, hematite origin: Walker, Theodore R. 00437
Products
Thermochemical treatment: Hess, Paul C. 10355
Well logging
Acoustical
Adaptability to planetary exploration: Szasz, S. E. 10405
Colorado oil shale, experimental: Baldwin, W. F. 10548
Applications
Water resources development: Pfannkuch, Hans-Olaf. 10499
Electrical
Adaptability to planetary exploration: Szasz, S. E. 10405
Automatic data processing, focus log analysis: Zenor, Hughes M. 10560
Experimental study, resistivity, pressure and temperature effect: Helander, Donald P. 10565
Interpretation, fractured reservoirs: Pirson, S. J. 00423
Interpretation, statistical, regional study: Keller, George V. 10567
Interpretation, water wells: Guyod, Hubert. 10397
Oil sand evaluation, Alberta-Saskatchewan: Brown, James S. 10547
Water wells, interpretation, problems: Alger, R. P. 10546
General
Automatic data processing, analysis, signal theory: Lindseth, R. O. 10561
Automatic data processing, interpretation: Gans, Philip. 10568
Automatic data processing, storage system, case history: Stauft, D. L. 10552
Interpretation, oil-finding tool: Pirson, S. J. 10402
Interpretation, techniques: Pirson, S. J. 00422
Well logging
Geophysical
Mineral exploration, drill holes: Zablocki, C. J. 10563
Magnetic
Methods, nuclear, permeability determination: Seevers, D. O. 10556
Methods
Canada, northern, problems: Nelner, S. H. 10566
Radioactivity
Adaptability to planetary exploration: Szasz, S. E. 10405
Gamma-gamma density, Colorado oil shale, experimental: Baldwin, W. F. 10548
Interpretation, water wells, gamma ray: Guyod, Hubert. 10397
Methods, gamma-ray neutron, potash exploration: Goldsmith, Louis H. 10557
Methods, neutron lifetime: Youmans, A. H. 10559
Methods, uranium exploration: Dodd, Philip H. 10558
Petroleum exploration: Pirson, S. J. 10564
Temperature
Heat-flow measurement: Simmons, Gene. 10555
Wells and drill holes
Alaska
Gulf of Alaska Tertiary province, subsurface stratigraphy: Plafker, George. 00452
Alberta
Rocky Mountain Foothills, Cretaceous, Smoky Group, logs: Stott, D. F. 00494
Florida
Escambia, Santa Rosa Counties, water wells: Musgrove, Rufus H. 10553
Hawaii
Oahu, Pearl Harbor area, Ewa Coastal Plain, cores: Stearns, Harold T. 00460
Kansas
Neosho County, water wells, logs: Jungmann, William L. 10417
Kentucky
Cayce quadrangle, lithologic: Olive, Wilds W. 00539
Logs, sources, bibliography and index maps: Howell, Paul. 10434
Maryland
Baltimore County, well records: Laughlin, Charles P. 10543
Charles County, water wells, logs and records: Slaughter, T. H. 10544
Salisbury area, well logs: Hansen, H. J., 3d. 10351
Mississippi
Hancock County, Mississippi Test Facility, water-well records: Newcome, Roy, Jr. 00338
Nevada
Eagle Valley, drillers' logs: Worts, G. F., Jr. 10609

Wells and drill holes
Texas
Brazos River, flood-plain alluvium, water wells: Cronin, James G. 00518
Utah
Asphalt Ridge area, well logs: Kayser, Robert B. 10358
Vermont
Otter Creek basin, water wells, test borings: Hodges, Arthur L., Jr. 00417
West Indies
Petrology
Bonaire, Washikemba formation, ignimbrites: Beets, D. J. 00365
Stratigraphy
Cretaceous, Washikemba formation, Bonaire: Beets, D. J. 00365
West Virginia
Stratigraphy
Silurian, Keyser Limestone, correlation with Rondout of New York: Hoar, Florence Grosvenor. 00557
Wisconsin
Areal geology
Florence, Marinette Counties, Menominee iron-bearing district: Bayley, R. W. 10407
Economic geology
Iron, Menominee district, reserves: Bayley, R. W. 10407
Geochemistry
Soils, inorganic phosphates, fractionation, method: Petersen, G. W. 10363
Geophysical surveys
Zinc-lead district, magnetic: Heyl, Allen V. 10441
Maps, geologic
Iron Mountain, Norway areas: Bayley, R. W. 10407
Menominee (Mich.) iron-bearing district, Precambrian: Dutton, Carl E. 00351
Structural geology
Zinc-lead district, general: Heyl, Allen V. 10441
Worms
Taxonomy
Treatise, additions: Rhodes, F. H. T. 10471
Wyoming
Geochemistry
Fremont County, zellerite, analyses, dehydration: Coleman, R. G. 10420
Precambrian graywacke, composition: Condie, Kent C. 00620
Maps, geologic
Antelope Gap quadrangle: McGrew, Laura W. 00461
Bordeaux quadrangle: McGrew, Laura W. 00462
Casebrier Hill quadrangle: McGrew, Laura W. 00465
Ferguson Corner quadrangle: McGrew, Laura W. 00466
Natwick quadrangle: McGrew, Laura W. 00467
Squaw Rock quadrangle: McGrew, Laura W. 00468
Wyoming
Maps, geologic
Wheatland quadrangle: McGrew, Laura W. 00469
Mineralogy
Zellerite, metazellerite, Fremont County, new: Coleman, R. G. 10420
Paleoclimatology
Tertiary, iron content of fossil bones: Houston, R. S. 10623
Paleontology
Fauna, Miocene-Quaternary, Casebrier Hill quadrangle, list: McGrew, Laura W. 00465
Fauna, Tertiary, Arikaree Formation, Natwick quadrangle, list: McGrew, Laura W. 00467
Fauna, Tertiary, Arikaree, White River Formations, Ferguson Corner quadrangle, list: McGrew, Laura W. 00466
Foraminifera, Cretaceous, Belle Fourche Shale: Eicher, Don L. 00312
Gastropoda, Cretaceous, Pierre Shale, Red Bird area: Sohl, Norman F. 00519
Mammalia, Eocene, Green River Formation, bat: Jepsen, Glenn L. 10432
Stratigraphy
Miocene-Quaternary, Casebrier Hill quadrangle, section: McGrew, Laura W. 00465
Xenon
Isotopes
Fissiogenic, meteorites, origin: Fisher, David E. 00463
X-ray diffraction analysis
Data
Beryl, Saskatchewan, Colorado: Radcliffe, Dennis. 10446
Bredigite, larnite, γ dicalcium silicates, Texas: Bridge, Thomas E. 10442
Hydroxyapatite, synthetic: McConnell, Duncan. 10667
Manganese minerals, Washington: Sorem, Ronald K. 00394
Muscovite, Maine, northwestern: Guidotti, C. V. 10427
Newberyite, California, Mono Lake: Cohen, Lewis H. 10424
Pyromorphite, synthetic: Baker, W. E. 10426
Resins, fossil and modern compared: Frondel, Judith W. 00412
Tantalite, tapiolite, wodginite, $FeTaO_4$, synthetic: Turnock, A. C. 10419
Tin apatite, synthetic: McConnell, Duncan. 10667
Zellerite, metazellerite, Wyoming, Fremont County: Coleman, R. G. 10420
Yukon
Absolute age
Saint Elias Mts., Neoglacial advances: Denton, George H. 10463
Glacial geology
Southwestern, Kaskawulsh, Donjek Glaciers: Denton, George H. 10463
Southwestern, Kaskawulsh Glacier: Borns, Harold W., Jr. 10464

Yukon
Maps, aeromagnetic
Carlisle Creek area: Canada Geological Survey. 00598
Donjek area: Canada Geological Survey. 00593
Excelsior Creek area: Canada Geological Survey. 00600
Fifteenmile River area: Canada Geological Survey. 00604
Garner Creek area: Canada Geological Survey. 00602
Los Angeles Creek area: Canada Geological Survey. 00599
Mackinnon Creek area: Canada Geological Survey. 00595
North Kluane area: Canada Geological Survey. 00594
Ogilvie area: Canada Geological Survey. 00601
Swede Creek area: Canada Geological Survey. 00603
Tom Creek area: Canada Geological Survey. 00597
Wellesley Lake area: Canada Geological Survey. 00596
Maps, geologic
Donjek Glacier terminus, surficial: Denton, George H. 10463
Paleoclimatology
Quaternary, southwestern: Borns, Harold W., Jr. 10464
Paleontology
Archaeocyatha, Cambrian, Mackenzie Mts.: Handfield, Robert C. 00567
Structural geology
Tintina Trench, strike-slip fault: Roddick, J. A. 00432
Zinc
Mississippi Valley
Upper, structural controls: Heyl, Allen V. 10441